cycles

—A MONTHLY REPORT

June—July 1954

FOUNDATION FOR THE STUDY OF CYCLES
New York, New York

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SUPPLEMENT

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cycles
—a monthly report

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VOLUME V NUMBER 6 JUNE—JULY 1954

The Director's Letter

Dear Member:

My Stock Market Forecast of 1944

A projection of certain stock market cycles which I made in 1944 has come true over a 10-year period with a gain-loss ratio of 156 to 1.

Although the excellence of the record is of course partly a matter of luck, I do not think it is all luck. I am therefore gratified.

I am also surprised. When the projection was made it was purely a reconnaissance. I was more or less having fun with figures. I took no stock in the results. In fact I forgot all about it until I came across it in the files in 1951, I think it was. Then I sat up and took notice!

The projection is dated January 25, 1944. It was signed by me at that time. It was distributed at that time to a group of clients of a large New York financial house who had paid me to dabble with these figures.

The projection successfully and accurately called the end, in 1946, of the then bull market (which had started in 1942). It successfully and accurately timed the bear market of 1946—1949. It called the bull market which began in 1949. It named 1954 as the most probable date for the end of that bull market.

Up to date the only error that this projection has made over a 10 year period would have cost you a loss of only 7/10 of 1% between 1952 and 1953.

As we have now reached 1954 it is appropriate to re-examine this projection in order to get a better idea of how much dependence we can place upon its forecast of an end *this year* to the bull market which began in 1949.

I have made such a re-appraisal for you. I have printed the results as the second article in this issue.

* * *

New Stock Market Forecast Needed

What you really need at this point is a *new* stock market forecast using all the figures up to date, and using all the cycle knowledge that has been developed during the past 10 years.

But you also want me to work out for you an actuarial basis for stock market trading. You also want to know all about the coming depression. You want to know what's ahead for commodity prices. And there are only so many hours in the day!

* * *

Forecasts of Company Sales

In December 1950 I published for you the results of an extensive investigation (made in 1949) in respect to the behavior of the 6-year cycle in various phenomena. The series studied included sales, income, and/or production of various important

American companies. The study projected this cycle into the future.

From time to time I have shown you how the 6-year cycle in these various figures has unfolded.

In the main it has come true very well. But of course the 6-year cycle does not always dominate. Crests and troughs in the actual figures sometime come ahead or after ideal timing.

These distortions are the results of trend, of other cycles, and of random factors. I cannot tell you in advance of the random factors, but I can tell you about other cycles, and I can throw a little light on trend.

To do this will help you in two ways: First, it will throw more light on what is ahead. Forecasts using a knowledge of two or three cycles should obviously be more accurate than forecasts using a knowledge of only one cycle. Second, by using two or three cycles and doing a better forecasting job you will have a better idea of the usefulness of a knowledge of cycles as a forecasting technique.

In an effort to meet your needs in this direction, I started some time back to make cycle studies of this sort. The work is continued in this issue with cycle studies of Continental Oil Company and du Pont.

If you have (or can get) the sales (or other) figures of any other large, well known company over a fairly long period of time (at least 25 years), and wish to send these figures to me, I will see if I can find time to do something with them too. If the figures are for your own company you might be willing to contribute something to help defray the cost of the work.

Very cordially yours,

Edward R. Dewey

Director

Research

CYCLES IN THE SALES OF DU PONT

Summary

The variations of du Pont sales to customers can pretty well be described in terms of 6- and 7.3-year cycles. Such a combination of cycles would largely offset each other at the present time, but would reappear in strength by 1959. If these cycles in these figures are significant we may expect such behavior to occur. In addition to the 6- and 7.3-year cycles, du Pont sales have been characterized by a 3 1/2-year cycle. Trend is still strongly upward.

The trend and cycles in combination suggest increased sales in 1954 relative to 1953, but a setback in 1955 relative to 1954.

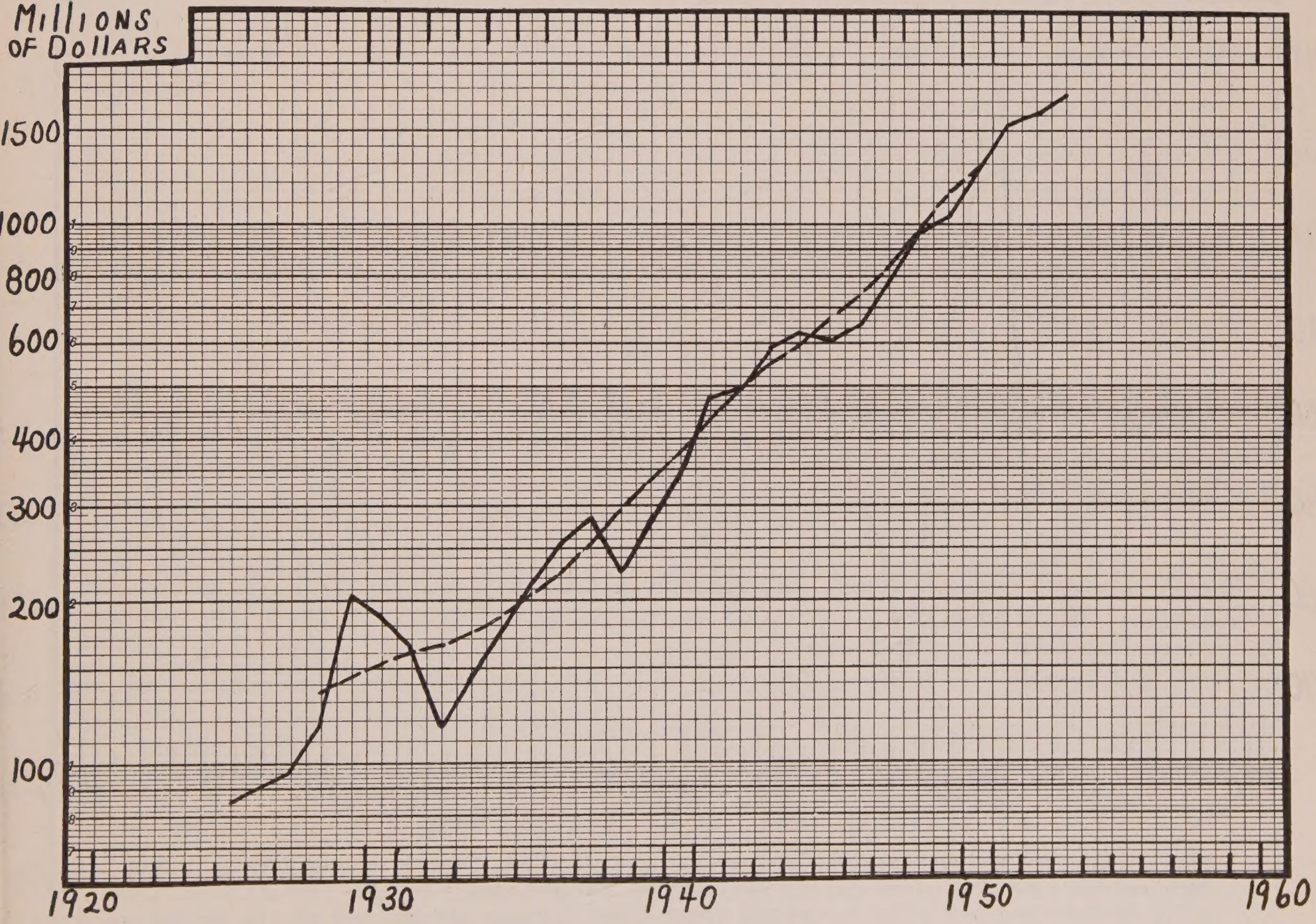


Fig. 1. E. I. du Pont de Nemours and Company sales to customers, 1925—1953. Note vigorous growth. Note decreasing amplitude (height, relative to trend) of the fluctuations. The broken line represents a 6-year moving average trend. The amounts by which the actual sales are above or below this trend are shown in Fig. 2 to follow. (Ratio Scale.)

FIG. 1 shows sales to customers by E. I. du Pont de Nemours and Company from 1925 through 1953.

Note that these sales have increased importantly but irregularly. Note also that these irregularities have shown strength at six or seven year intervals. Finally, note that latterly these irregularities are of smaller strength or amplitude than they were formerly.

The irregularities can be seen more easily and be studied better if we express sales as percentages of trend as in Fig. 2.

In commenting upon these fluctuations from the standpoint of cycles let it be said at once that the observed rhythm or tendency toward regularity could easily have come about as a result of chance. There are not enough repetitions (waves) of a six or seven year cycle to justify the *conviction* that they have been brought about by cyclic forces.

On the other hand, the timing of these waves corresponds to the timing of similar waves in other series of figures which *are* long enough to suggest significance. This being so, significance of these waves in du Pont sales would seem to be more than a possibility.

With reference to the fact that these fluctuations have decreased in strength over the years, let it be freely admitted

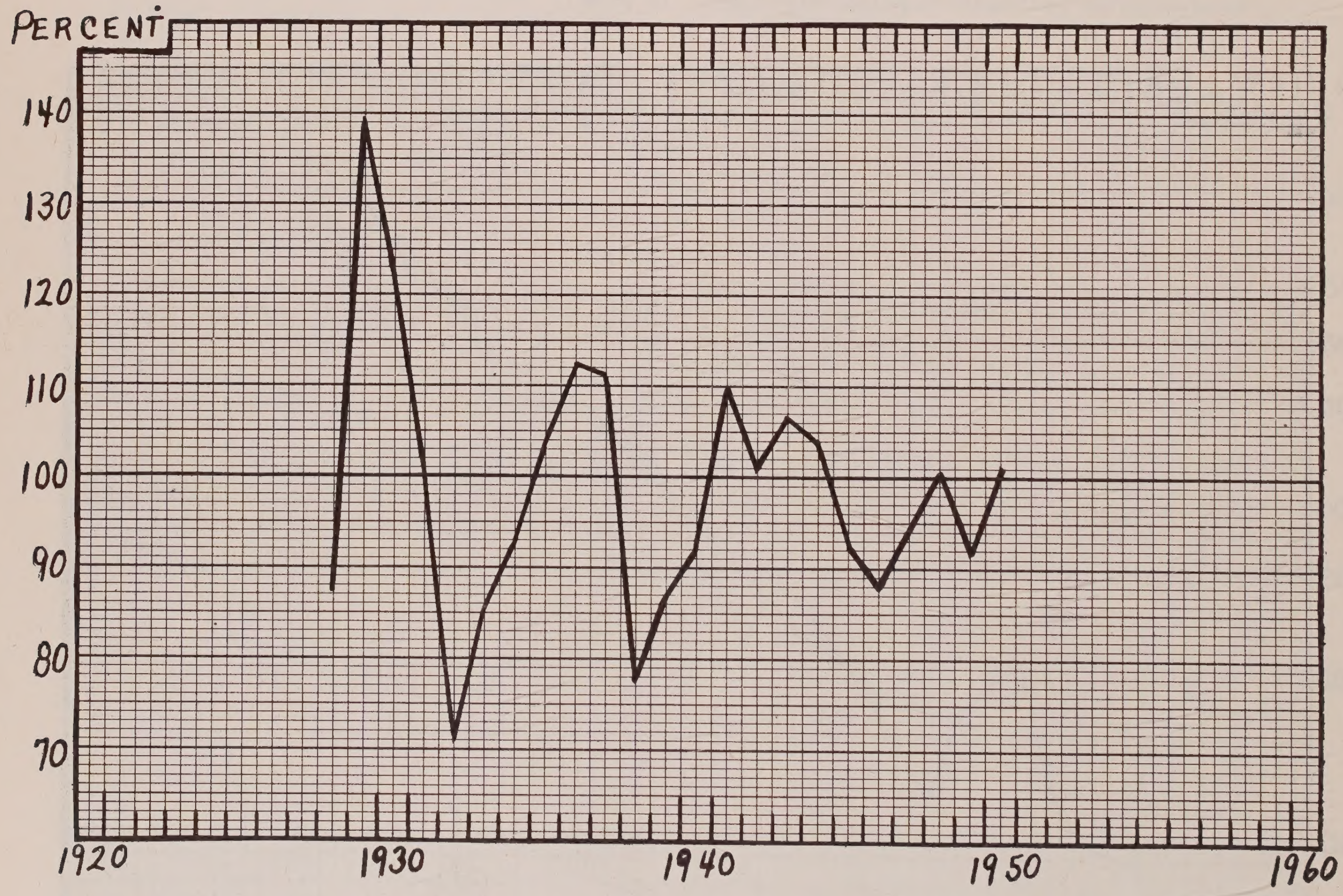


Fig. 2. Du Pont sales expressed as percentages of their 6-year moving average trend. Such percentages are often called deviations. Percentages run from 1928 through 1950 only, because the method of computing trend loses 3 years at each end of the series of figures. Note 6- or 7-year cycle which has faded out over the years.

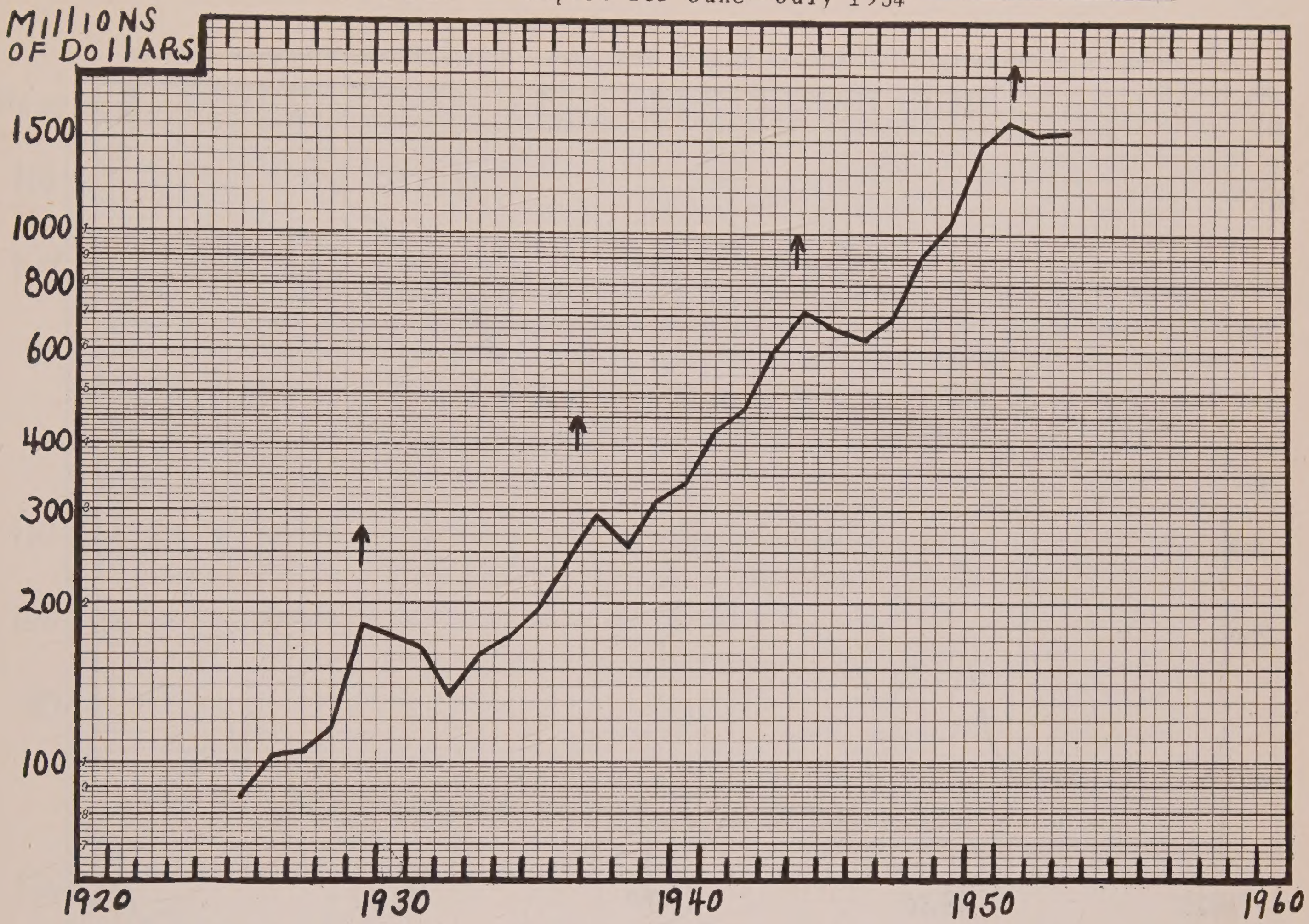


Fig. 3. Du Pont sales (Fig. 1) adjusted to eliminate the effect of a perfectly regular 6-year cycle. Note that a cycle about 7.3 years long remains, as indicated by the arrows. (Ratio Scale.)

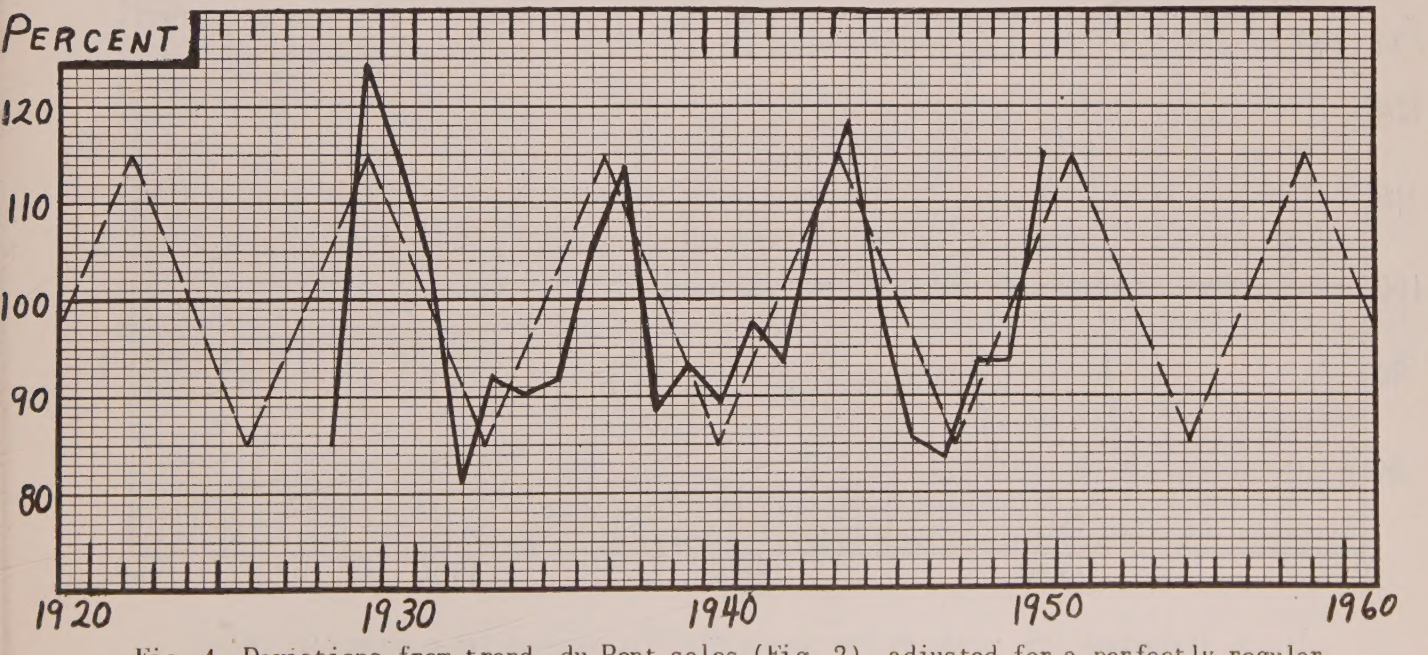


Fig. 4. Deviations from trend, du Pont sales (Fig. 2). adjusted for a perfectly regular 6-year cycle. Note that a cycle about 7.3 years long remains which does not fade out. The 7.3-year cycle is diagramed by means of a broken zig-zag line, projected into the future.

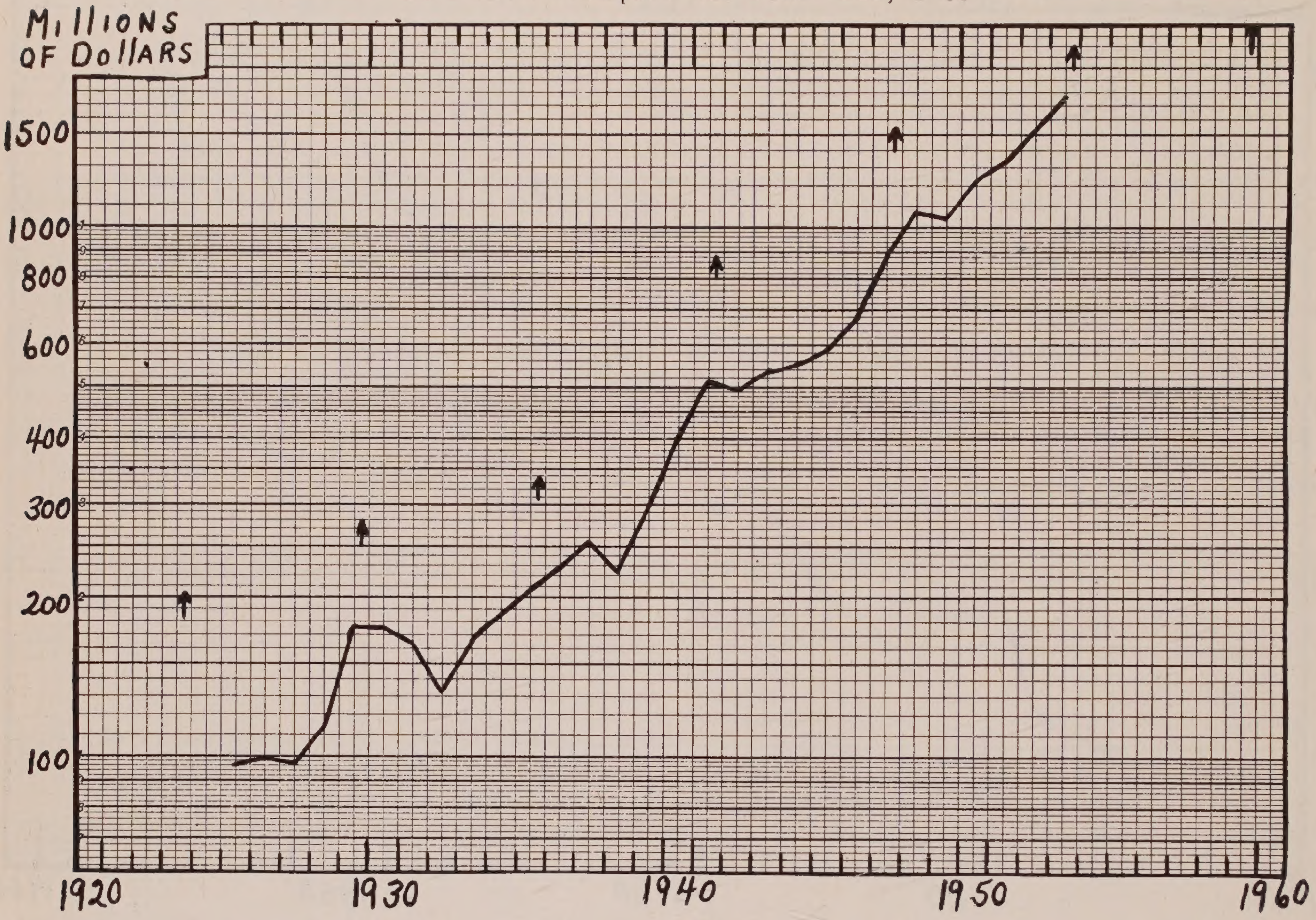


Fig. 5. Du Pont sales (Fig. 1), adjusted to eliminate the effect of a perfectly regular 7.3-year cycle. Note that a cycle about 6 years long remains, as indicated by the arrows. (Ratio Scale.)

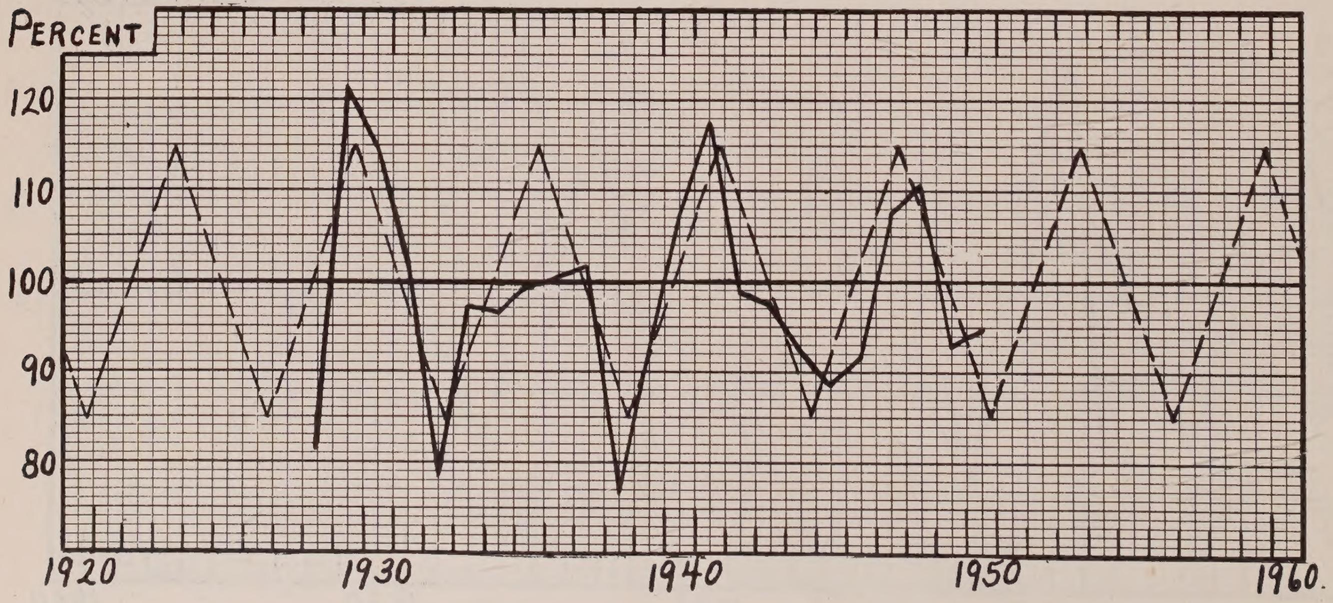


Fig. 6. Deviations from trend, du Pont sales (Fig. 2), adjusted for a perfectly regular 7.3-year cycle. Note that a cycle about 6 years long remains which does not fade out. The 6-year cycle is diagramed by means of a broken zig-zag line projected into the future.

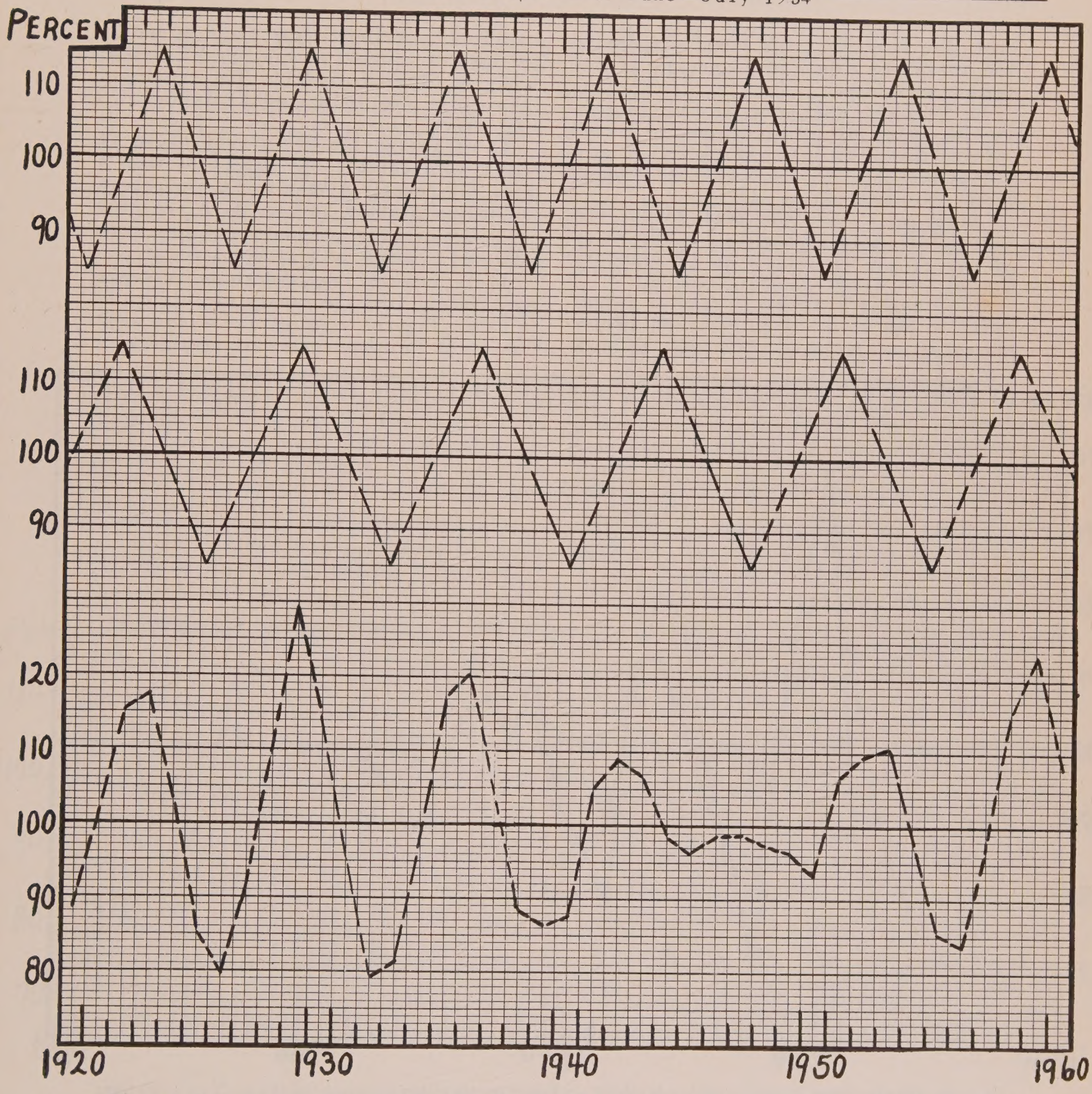


Fig. 7. Diagrams of (A) the 6-year cycle, (B) the 7.3-year cycle in the deviations, and their synthesis or combination.

As the deviations are from a 6-year moving average the 7.3-year cycle in these deviations has been reduced in amplitude (height). That is why the strength shown in this diagram is not quite as great as the strength named in the text, which applies to the strength of this cycle in the actual sales.

Note that in the 1930's the cycles were together, re-enforcing each other. In the late 1940's they opposed each other. A continuation of the cycles will come together again in the late 1950's and in the 1960's.

that this behavior could easily be due to the increased size and diversity of the company operations.

On the other hand, similar fluctuations in the sales of other companies which have increased in size and diversity have not faded out. Consequently, I cannot accept this explanation easily.

Also, as I told you last month, the fading out could be due to the interplay of two cyclic forces. I am inclined to believe this is the true explanation.

If we assume a perfectly regular 6-year cycle in the sales of du Pont and adjust the sales to eliminate the effect of such a perfectly regular 6-year cycle we obtain the figures plotted in Fig. 3. A 7.3-year cycle is clearly evident. The crests of this cycle are indicated by arrows 7.3 years apart.

If we adjust the *deviations* shown in Fig. 2 to eliminate the effect of such a perfectly regular 6-year cycle, we obtain the values plotted in Fig. 4. A 7.3-year cycle is clearly evident, and has been diagramed by means of a broken line.

It is interesting, and to me it seems significant, that the crests of this cycle in these figures come at the times when this cycle in other series of figures also

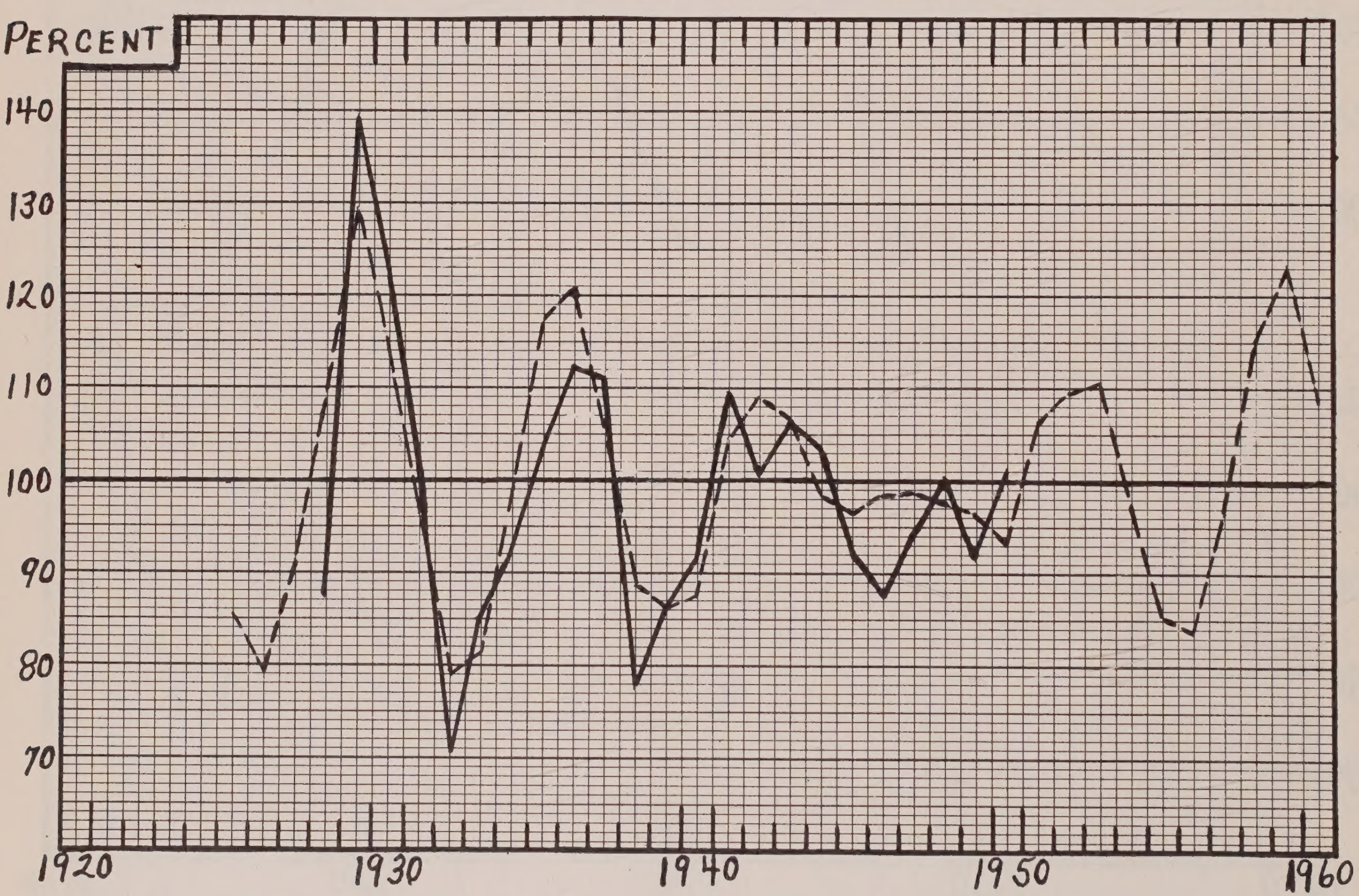


Fig. 8. Deviations from trend, du Pont sales to customers (same as Fig. 2), together with a synthesis or combination of the 6- and the 7.3-year cycles (from Fig. 7).

Remember that these cycles are conjectural. The series of figures is not long enough to know whether or not cycles of these lengths are significant.

If the fading out of the 6- to 7-year cycle was not due to the combined effect of 6- and 7.3-year cycles it will doubtless fail to reappear. However, if it was due to the effect of these two cycles offsetting each other, it should reappear as diagramed for the future. At present no one can know without earlier data. We must wait and see.

crest.

If now we adjust the original figures for the effect of the perfectly regular 7.3-year cycle, a 6-year cycle of reasonably uniform amplitude which does *not* fade out remains. Crests are shown in Fig. 5 by a series of arrows 6-years apart.

If, as above, we adjust the same *deviations* (Fig. 2) for the effect of a perfectly regular 7.3-year cycle as in Fig. 6, a 6-year cycle of reasonable uniformity becomes clearly evident. In Fig. 6 the 6-year cycle is diagramed by a broken line.

Fig. 7 shows the ideal 6-year cycle, the ideal 7 1/3-year cycle, and their combination.

Fig. 8 shows the combination of these cycles in comparison with the percentage departures from trend. The projection indicates what will happen if the behavior observed is the result of cyclic forces of these lengths, and if they continue.

As indicated by the projection in Fig. 8, if the 6-7 year tendency which has been fading out was really caused by the interaction of 6- and 7.3-year cycles, the 6-7 year wave may be expected to reappear. If it does, we will have our faith in the reality of this concept increased. If it does not, we must conclude either that the 6-7 year cycle was present merely as a result of random forces or that it has faded out due to a change in the nature of the company's operation.

Be that as it may, if we adjust the deviations (Fig. 2) for *both* the 7.3- and 6-year cycles we get the values shown in Fig. 9. A 3 1/2-year cycle is clearly evident and has been diagramed by means of a broken zig-zag line.

If we now adjust the actual sales (Fig. 1) for the effect of 6-year, 7.3-year and 3 1/2-year cycles we obtain the solid line charted on Fig. 10. This line represents growth and inflation factors, war distortions, other random elements, and other cycles (perhaps one about 11 years in length?).

Except as other cycles can be discovered in these figures, all the factors contained in Fig. 10 must be forecast

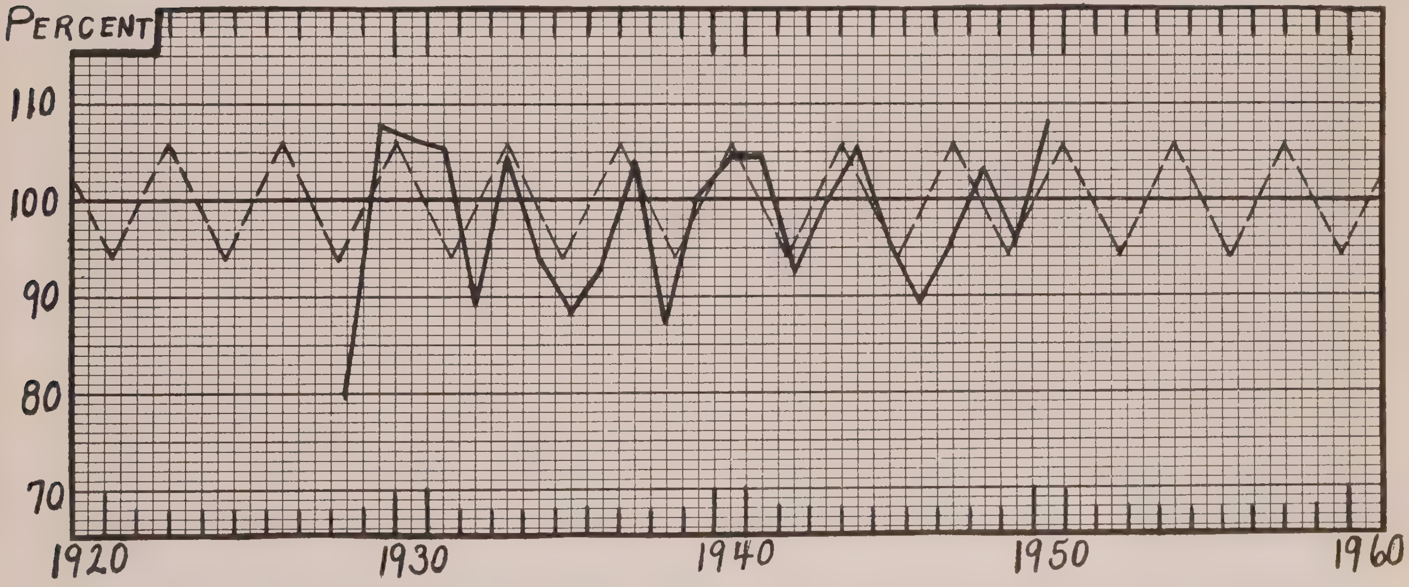


Fig. 9. Du Pont sales to customers, expressed as deviations from trend, after adjustment for the effect of both the 6- and the 7.3-year cycles. Note that a very clear 3 1/2-year cycle remains. It has been diagramed by means of a broken zig-zag line.

Without the use of monthly figures it is not possible, in a series of figures as short as this, to determine the exact characteristics of a cycle as short as 3 1/2 years.

separately without reference to cycles. On the other hand, until you have isolated the 6-, 7.3-, and 3 1/2-year cycles and removed them to obtain the figures plotted in Fig. 10 you do not have an exact measure of what these other factors amount to.

As the curve in Fig. 10 is relatively smooth, we can assume that it may continue in the same general direction in which it has been going. Such a projection is perhaps as good as an uninformed person such as myself can make. It may serve general purposes. Even for general purposes, however, it should be revised annually as events unfold and slight changes in direction occur.

For the sake of the record it may be well at this point to give the characteristics of the three chief cycles observed in du Pont sales. The 6-year cycle crests ¼ year after mid 1953 and at six year intervals forward and backward from that date. Troughs come three years after crests. The amplitude of the cycle is 115% of trend at crest, 85% of trend at trough.

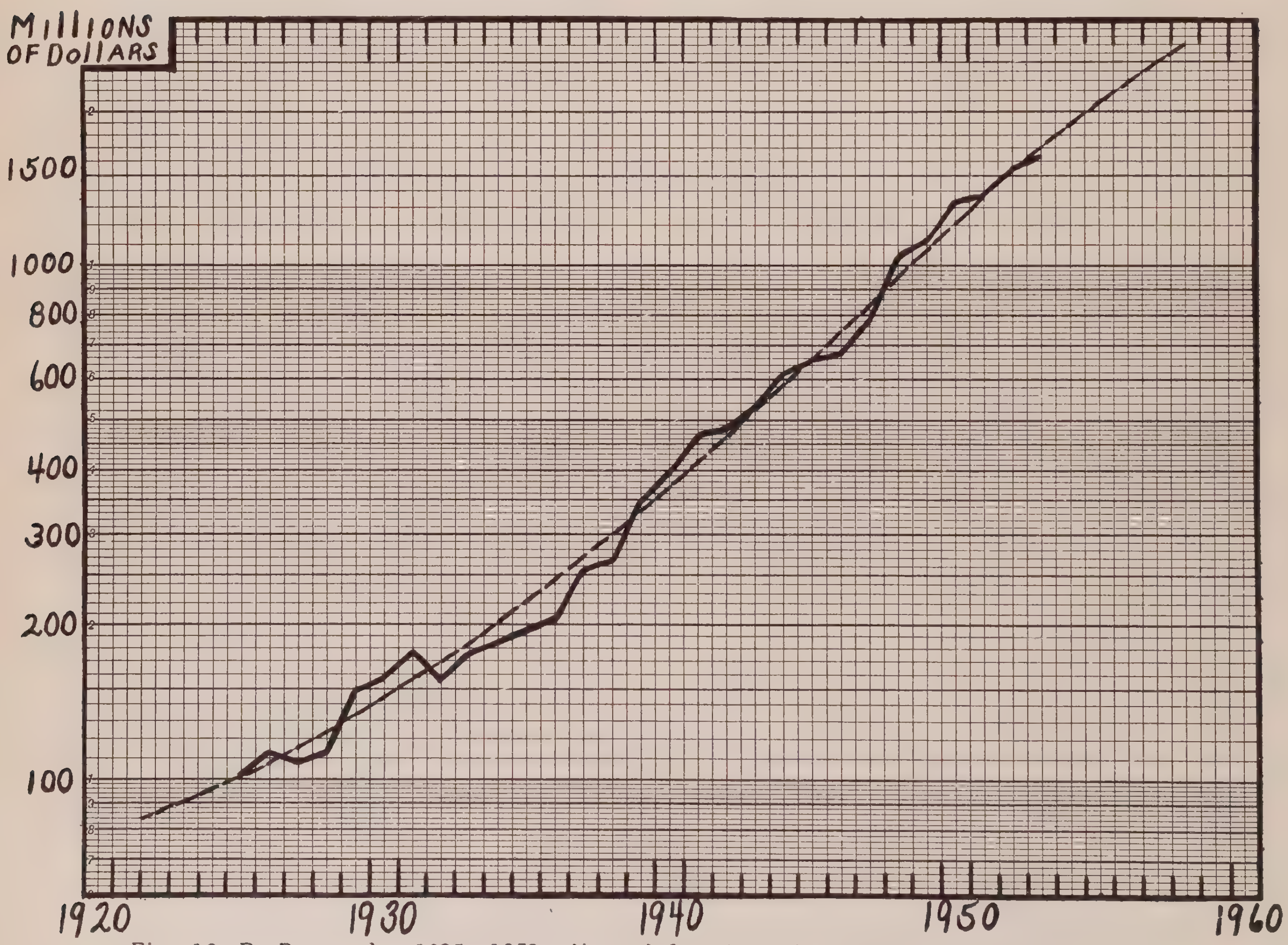


Fig. 10. Du Pont sales 1925—1953 adjusted for the effect of 6-, 7.3-, and 3 1/2-year cycles. An estimate of underlying long term growth trend has been added by means of a broken line. (Ratio Scale.)

The 7.3-year cycle crests mid 1951 and 7.3-years forward and backward from that date. It has an amplitude of 118% of trend at time of crest, 82% of trend at time of trough.

The 3 1/2-year cycle crests in 1954 and 3 1/2-years forward and backward from that time. It has an amplitude of 105.9% of trend at time of crest, 94.1% of trend at time of trough.

Forecast

Putting all of this together is very easy. You just multiply the values of the trend by the corresponding values of each cycle to obtain the broken line in Fig. 11. This line represents the combined effect of the postulated 6-, 7.3-, and 3 1/2-year cycles and trend. You can see how well such a combination describes previous behavior by comparing it with actual sales, charted in Fig. 11 by means of a solid line.

You can also see the configuration of the sales chart of the future, at least in rough outline. It suggests an increase of about 2 1/2% for 1954, a decrease of about

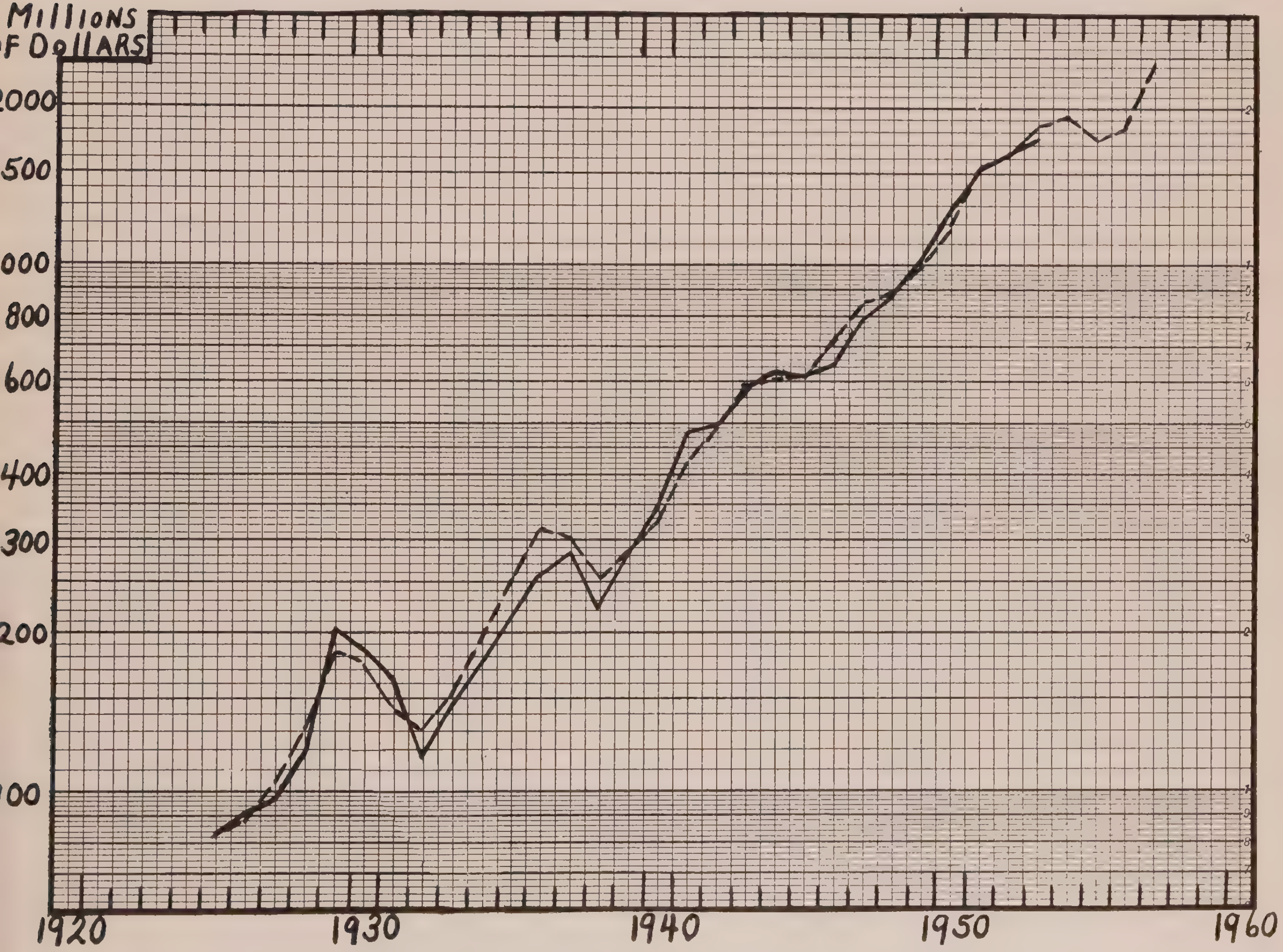


Fig. 11. E. I. du Pont de Nemours and Company sales to customers 1925—1953 together with (broken line) combination of estimated trend and the postulated 6-, 7.3-, and 3 1/2-year cycles.

The combination or synthesis has been projected three or four years into the future to give a general idea of the configuration of the sales curve if the indicated behavior continue. (Ratio Scale.)

9 1/2% for 1955. An increase of about 6% for 1956. As for 1957, it is too risky at this stage of things to say more than that a vigorous upturn may be in the cards.

Do not take these percentages too literally, for I do not have access to monthly figures and variation between the actuals and the synthesis of trend and the determined cycles have often run as much as 7 or 8% in years past, as you can see from the following table. Moreover, as stated above, as yet we do not *know* that the damping out of the 6-7-year cycle really was the result of the interplay of 6- and 7.3-year cycles.

Putting it better, a synthesis of the 3 1/2-year cycle and the postulated 6- and 7.3-year cycles suggest that du Pont sales to customers for 1954 will exceed sales for 1953, but that the corresponding figure for 1955 will be below the sales for 1954. The upturn should then follow.

Conclusion

For the immediate future, sales of du Pont should fluctuate around the trend line within a rather narrow range. This is the probability regardless of whether the recent stability is caused by the interplay of the indicated cyclic forces or otherwise.

However, if the behavior of the last 28 years *is* the result of an interplay of cyclic forces, we can look forward to fluctuations of increased amplitude as time goes on.

If such increased fluctuations do occur they will tend to substantiate the idea of significant cycles of the indicated lengths.

E.R.D.

TABLE I

Year	Actual Sales in Millions of Dollars	Estimated Trend of Millions of Dollars	6-yr. Cycle in %	7.3-yr. Cycle in %	3 1/2-yr. Cycle in %	Combination in Millions of Dollars	Percent Error of Combination
1946	648.7	745.5	102.5	95.0	99.2	720.3	+11.0
1947	783.4	840.	112.5	85.0	105.9	850.4	+ 8.6
1948	968.7	950.0	107.5	88.4	99.2	894.9	-7.6
1949	1,024.8	1,081.5	97.5	98.3	95.8	992.8	-3.1
1950	1,297.5	1,220.	87.5	108.3	102.5	1,189.5	-8.3
1951	1,531.1	1,380.	92.5	115.3	102.5	1,547.0	+ 1.0
1952	1,603.0	1 530.	102.5	108.3	95.8	1,626.4	+ 1.5
1953	1,765.4	1,700	112.5	98.3	99.2	1,864.9	+ 5.6
1954	?	1,900.	107.5	88.4	105.9	1,911.4	?
1955	?	2,100.	97.5	85.0	99.2	1,726.2	?
1956	?	2,300.	87.5	95.9	95.8	1,831.0	?
1957	?	2,500.	92.5	105.0	102.5	2,487.5	?

MY STOCK MARKET FORECAST OF 1944

by Edward R. Dewey, Director
Foundation for the Study of Cycles, Inc.

Summary

A projection of 10 possible stock market cycles made in January 1944 correctly called for 1946 as the end of the bull market, correctly called for 1949 as the end of the bear market, and called 1954 as the end of the bull market which followed. Up to date this forecast has come true with a gain-loss ratio of 156 to 1.

In view of this record, can 1954 be counted on as the peak of the bull market which began in 1949? The answer is no. The comparison of the synthesis of various cycles with actual behavior 1854—1943 shows many instances where behavior has diverged from the cycle pattern determined in 1944. Many divergencies will doubtless occur in the future. A cycle study based only on cycles over 4 1/2 years in length cannot be counted upon to call the turns to the exact year. The success of the forecast 1943 to date is therefore partly a matter of luck. On the other hand the success of this forecast cannot reasonably be all luck. This fact that we are well above trend at the present time suggests that in the general neighborhood of 1954 we should see the peak, and that a fairly important bear market cannot reasonably be very far away.

IF a stock market projection which I made in 1944 continues to work, the bull market which began in 1949 is due to end this year.

What are the probabilities that it will do so?

To enable you to answer this question I must tell you something more about this projection: how it was made; how it has worked; its strengths; its weaknesses.

Figures Used

To make this projection I made a study of the ups and downs of the Clement-Burgess Index of common stock prices (mostly railroads) 1854—1870 adjusted to tie on to the Standard and Poor's Corporation Combined Index, (industrials, rails, and utilities) 1871—1943. I used only annual averages.

Obviously the projection does not pertain directly to the Axe-Houghton, New York Times, Dow-Jones, or other indexes. Nor does it pertain directly to the Standard and Poor's Corporation Railroad Index, Utility Index, or Industrial Index. Even though all these indexes go up and down more or less together, it pertains directly only to the Standard and Poor's Corporation *Combined Index*, and must be judged by the behavior of that index alone.

Obviously, too, the projection must, like the data used, be in terms of annual averages. To make a projection on a monthly basis, or on a weekly, or on a daily basis, you must use monthly, weekly, or daily data. This is much harder.

The index used is charted in Fig. 1 below.

Trend Upward at 1.8% Per Annum

If you study Fig. 1 you will notice that the curve slopes irregularly upward from left to right. This upward slope is called the trend. It was determined in 1939 by the Cowles Commission for Economic Research to be typically 1.8% per annum, 1871 through 1938. Trend at the same rate is projected forward from 1939 through 1990, even though, with 15 more

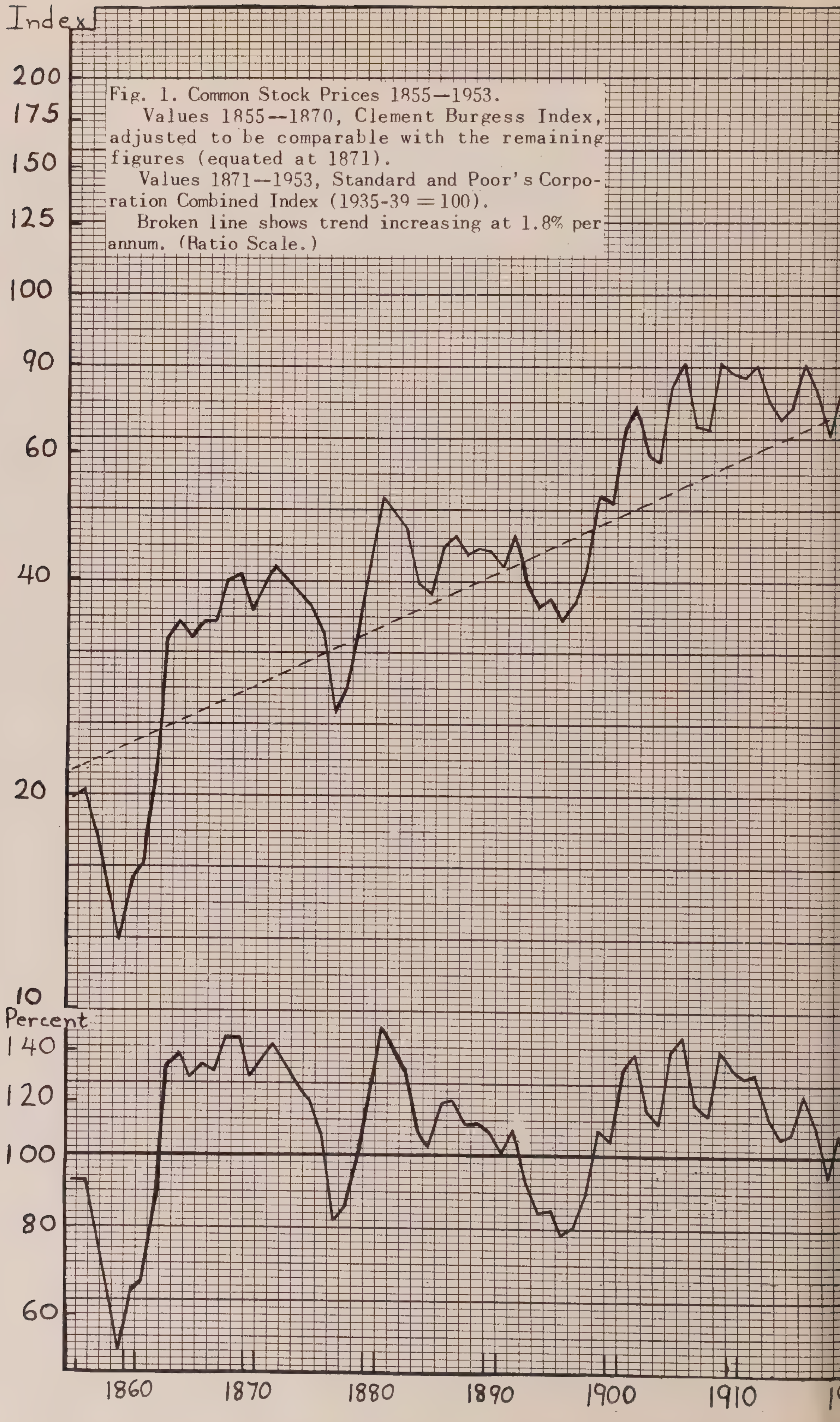


Fig. 1. Common Stock Prices 1855--1953.

Values 1855--1870, Clement Burgess Index, adjusted to be comparable with the remaining figures (equated at 1871).

Values 1871--1953, Standard and Poor's Corporation Combined Index (1935-39 = 100).

Broken line shows trend increasing at 1.8% per annum. (Ratio Scale.)

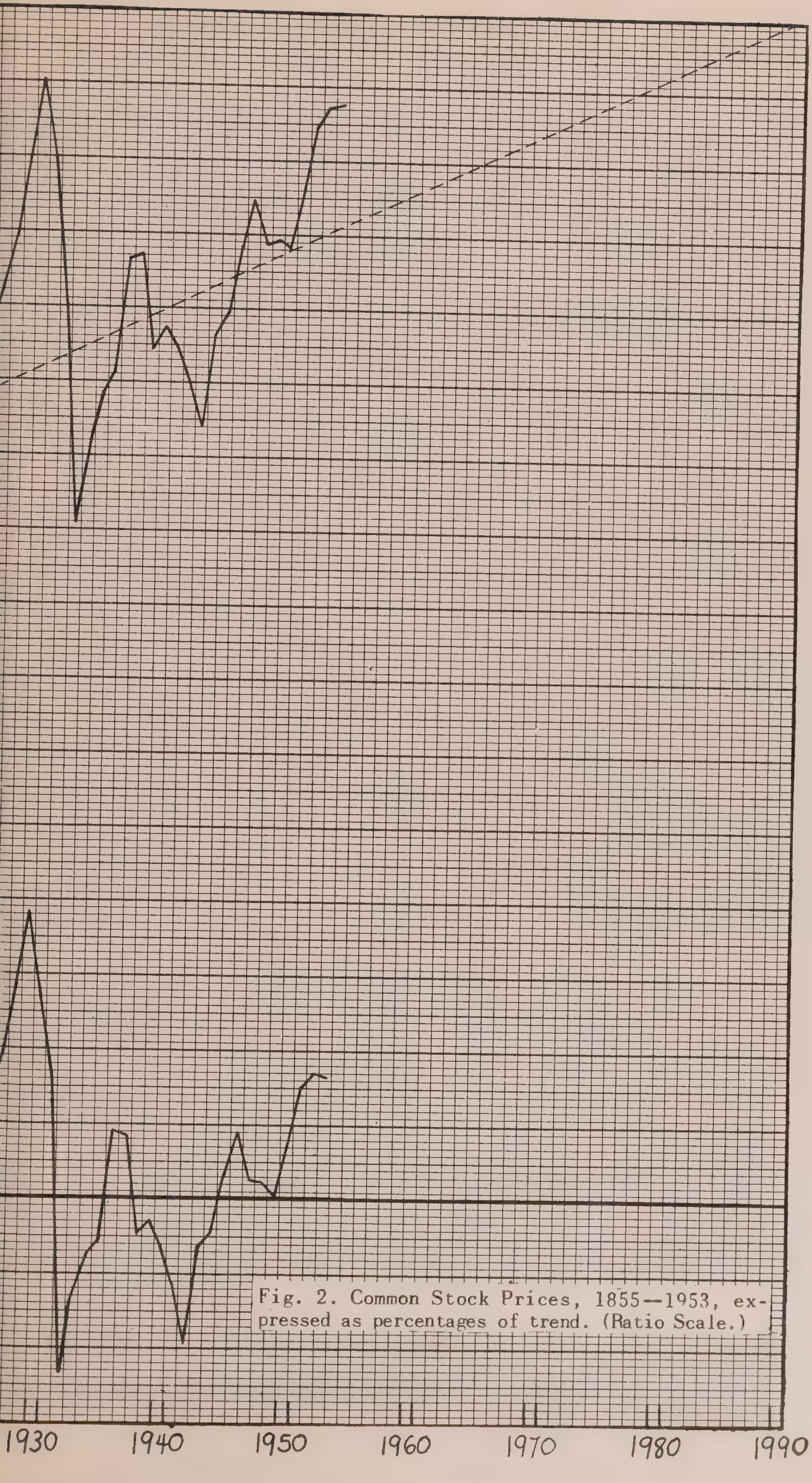


Fig. 2. Common Stock Prices, 1855—1953, expressed as percentages of trend. (Ratio Scale.)

Fig. 3

TEN POSSIBLE CYCLES IN THE STOCK MARKET AND THEIR SYNTHESIS,

1854-1990

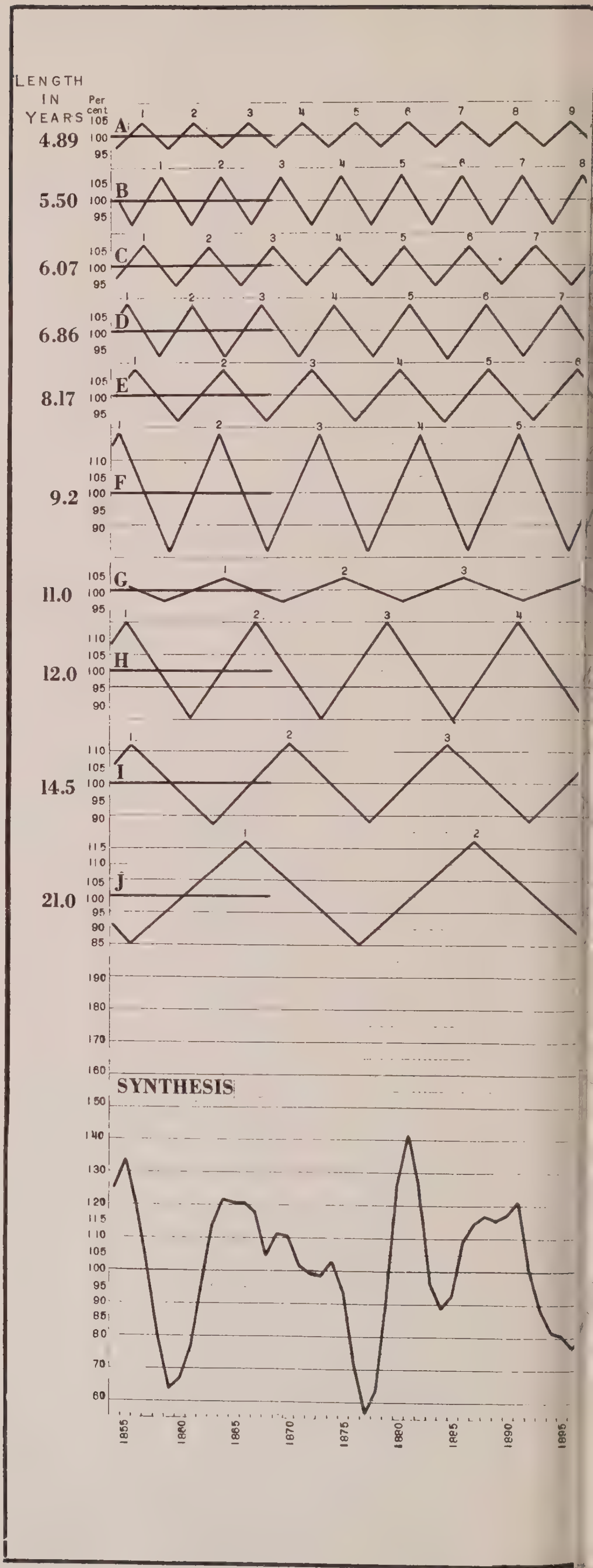
CURVES A to J inclusive diagram ten cycles which were revealed as possibly present in the stock market by a preliminary analysis made in 1943 and 1944.

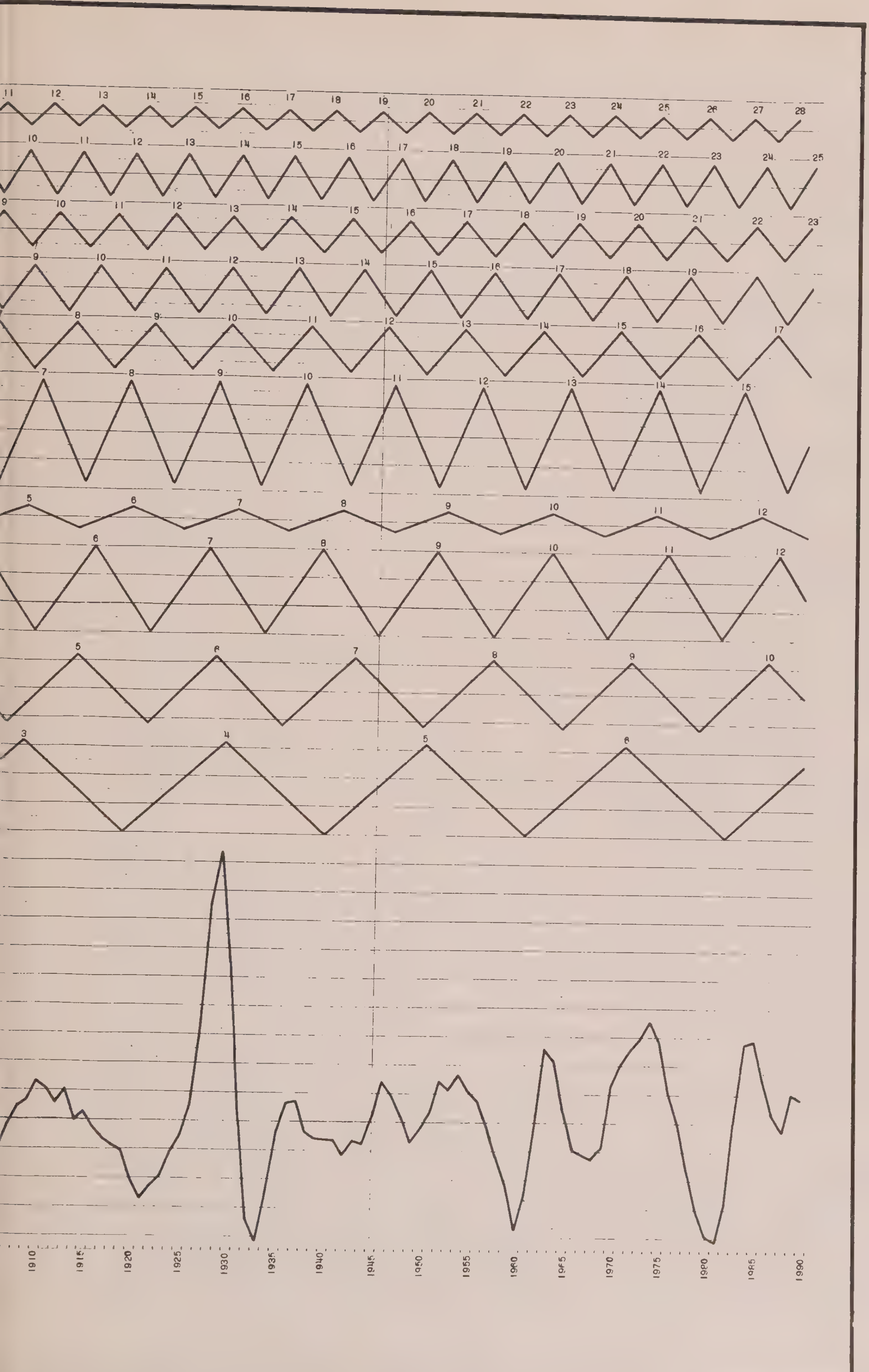
The synthesis shows the combined effect of cyclic forces of these wave lenfths

The synthesis shows the combined effect of cyclic forces of these wave lengths, strengths, and timings.

This chart illustrates the principle of cycle combination and shows how any cycle can sometimes be overwhelmed by several other cycles in combination.

The projection will bear some relation to actual future behavior only if the indicated cycles have been correctly determined as to length, strength, and timing, if they are real, and if they continue.

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years of figures, a similar determination made at the present time might be slightly different. Also, it might be mentioned that other students might have adopted a smooth curved line instead of a smooth straight line to characterize trend. It is a matter of judgment, but, in this instance, relatively unimportant.

Rhythms Also Apparent

In addition to trend you will notice many more or less irregular ups and downs. It is these in which you are particularly interested.

You can study these ups and downs better if we adjust the index for trend—that is, if we compute the percentage that each one of the various values of the index is of the corresponding value of the trend. This has been done and the results are plotted in Fig. 2.

Now if you will look closely at Fig. 2, or at Fig. 1 for that matter, you will see that some of the peaks—or more exactly, areas of strength—come at more or less equal distances from each other. That is to say, the curve behaves as it would behave if there were some perfectly regular forces playing upon it—along with random forces—to force it alternately up and down. This tendency for strength at reasonably uniform time intervals—and of course with intervening weakness—is called *rhythm*.

The 10 Cycles

My study of 1944 showed ten rhythms, or cycles as they are often called, over 4 1/2 years in length, easily discoverable in the figures up to that date. These cycles are diagramed in Fig. 3. They have the following characteristics:

The 4.89-Year Cycle

Crests at 1861 and every 4 8/9 years forward and backward from that date. Typical strength, 3.5% above its trend at time of crest.

The 5.50-Year Cycle

Crests at 1864 and every 5 1/2 years forward and backward from that date. Typical strength, 7.0% above its trend at time of crest.

The 6.07-Year Cycle

Crests at 1905 and every 6 1/14 years forward and backward from that date. Typical strength, 6.0% above its trend at time of crest.

The 6.86-Year Cycle

Crests at 1854 and every 6 6/7 years forward and backward from that date. Typical strength, 8.3% above its trend at time of crest.

The 8.17-Year Cycle

Crests at 1872 and every 8 1/6 years forward and backward from that date. Typical strength, 8.2% above its trend at time of crest.

The 9.2-Year Cycle

Crests at 1854 and every 9 1/5 years forward and backward from that date. Typical strength, 17.2% above its trend at time of crest.

The 11-Year Cycle

Crests at 1864 and every 11 years forward and backward from that date. Typical strength, 3.8% above its trend at time of crest.

The 12-Year Cycle

Crests at 1855 and every 12 years forward and backward from that date. Typical strength, 15.1% above its trend at time of crest.

The 14.5-Year Cycle

Crests at 1870 and every 14 1/2 years forward and backward from that date. Typical strength, 12.25% above its trend at time of crest.

The 21-Year Cycle

Crests at 1866 and every 21 years forward and backward from that date. Typical strength, 17.0% above its trend at time of crest.

When expressed in logarithms the typical waves of all rhythms seem to be zigzag in shape, and symmetrical.

The Cycles Projected

Obviously these rhythms can be projected into the future as far as you like. Thus each one can be used not only to represent a portion of what has happened but a portion of what will happen, if the rhythm continues. Moreover, it is a matter of the simplest arithmetic to compute the combined effect of the rhythms, not only for the past but for the future also. This also is done for you in Fig. 3, and in Fig. 4.

How the Projection Worked Out

As you can see, the projection correctly forecast that the bull market, which had started in 1942, would continue through 1944 and 1945 to reach a peak in 1946. This happened. The projection then forecast that this peak would be followed by three years of decline to 1949. This also occurred. The projection then forecast a five year bull market, ending in 1954.* (See Fig. 5.)

At this writing (April 21, 1954), no one knows whether 1954 as a whole, in the combined index, will outtop 1953. Nor is it known whether or not an important decline will follow. However, up to and including the last of a series of imaginary transactions the record would have been as follows:

Year	Buy at	Sell and Short at	Cover at	Gain or Loss	% Gain or Loss
1944	99.8				
1946		139.9		40.1	40.2
1946		139.9			
1949			121.4	18.5	13.2
1949	121.4				
1952		187.7		66.3	54.6
1952		187.7			
1953			189.0	− 1.3	− .69
1953	189.0				
1954		?		?	?

As you can see, the percentage gains 1944 through 1953 were 156 times the percentage losses. Whether the purchase called for in 1953 and the sale called for in 1954, and the short sale called for 1954 and the cover called for in 1960 will also prove profitable, of course no one yet knows.

The levels were not forecast as accurately as the turning points, If we adjust the index to a gold basis, 1943 = 100, we get the comparison shown in Fig. 6, which is quite satisfactory. However, I am not at all sure that the upward surge of the past few years is due to inflation, although of course in part it may be.

Will the Top Come in 1954?

Will the crest predicted for 1954 come as forecast? Can you rely on this prediction?

Let us look at the pros and cons:

The arguments *against* reliance on 1954 as the turning point in the annual averages of the Standard and Poor's Corporation Combined Index are as follows:

1. Some of the observed cycles may have been present as a result of random forces rather than cyclic forces. Clearly, if cycles are present as a result of random forces they cannot be expected to continue.

2. Even significant cycles (that is to say cycles present as the result of cyclic forces) may, because of a compound nature, fade out in the course of time.

3. The projection being discussed did not include any cycles less than 4 1/2 years in length. There are without question shorter cycles in this series of figures. Their influence might advance or retard the crest from the time indicated by the longer cycles.

4. There may be other as yet undiscovered longer cycles in this series of figures. These additional longer cycles might also modify the time of the current crest.

5. It is unreasonable to imagine that all the ups and downs of the stock market are due to cyclic forces. Random factors undoubtedly play an important part. The forecast, by its very nature, cannot take these random factors into account.

6. In some instances the true cycle length may be a little longer or shorter than as determined. Also the amplitude may be a little greater or a little less. Note that errors of length are cumulative. An error of half a year in the length of a cycle will throw that particular cycle out two full years in four repetitions.

7. A comparison of the combination of all 10 cycles and trend with the actuals (Fig. 4 and Fig. 7.) show many divergencies. These divergencies are the result of random factors, shorter cycles, other longer cycles, incorrect cycle determination, etc. It is unreasonable to expect that there will not be divergencies in the

---

*THE FALTERING IN THE ADVANCE SHOWN FOR 1953 IN FIGS. 3, 5, AND 6 IS DUE TO A SMALL ARITHMETIC ERROR MADE IN 1944 AT THE TIME THESE 10 CYCLES WERE COMBINED. THE RESULTS MUST HOWEVER BE JUDGED ON THE FORECAST AS IT WAS ACTUALLY MADE AT THAT TIME. THIS HAS BEEN DONE. THE CORRECT VALUE FOR THE PROJECTION IS SHOWN IN FIG. 4.

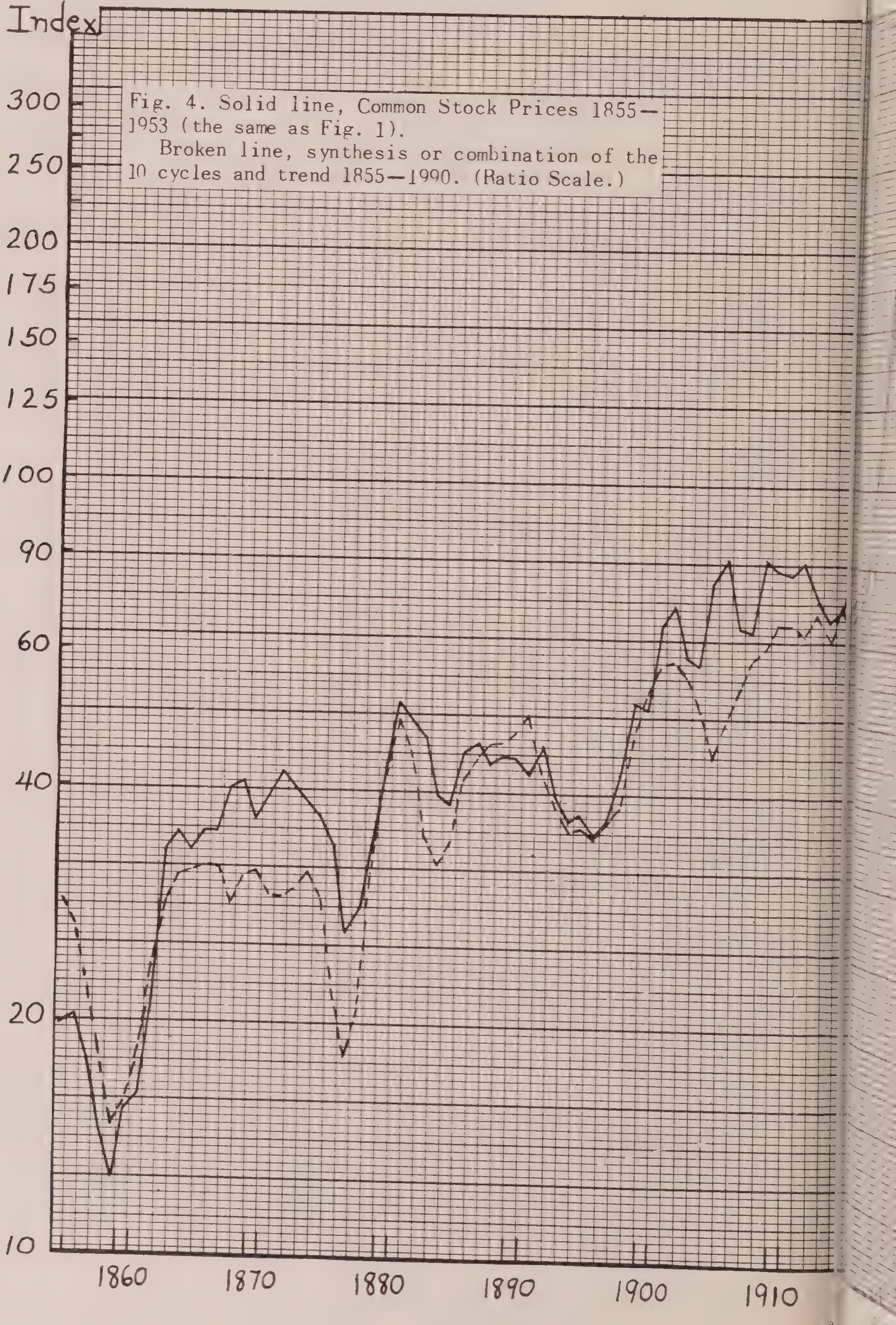
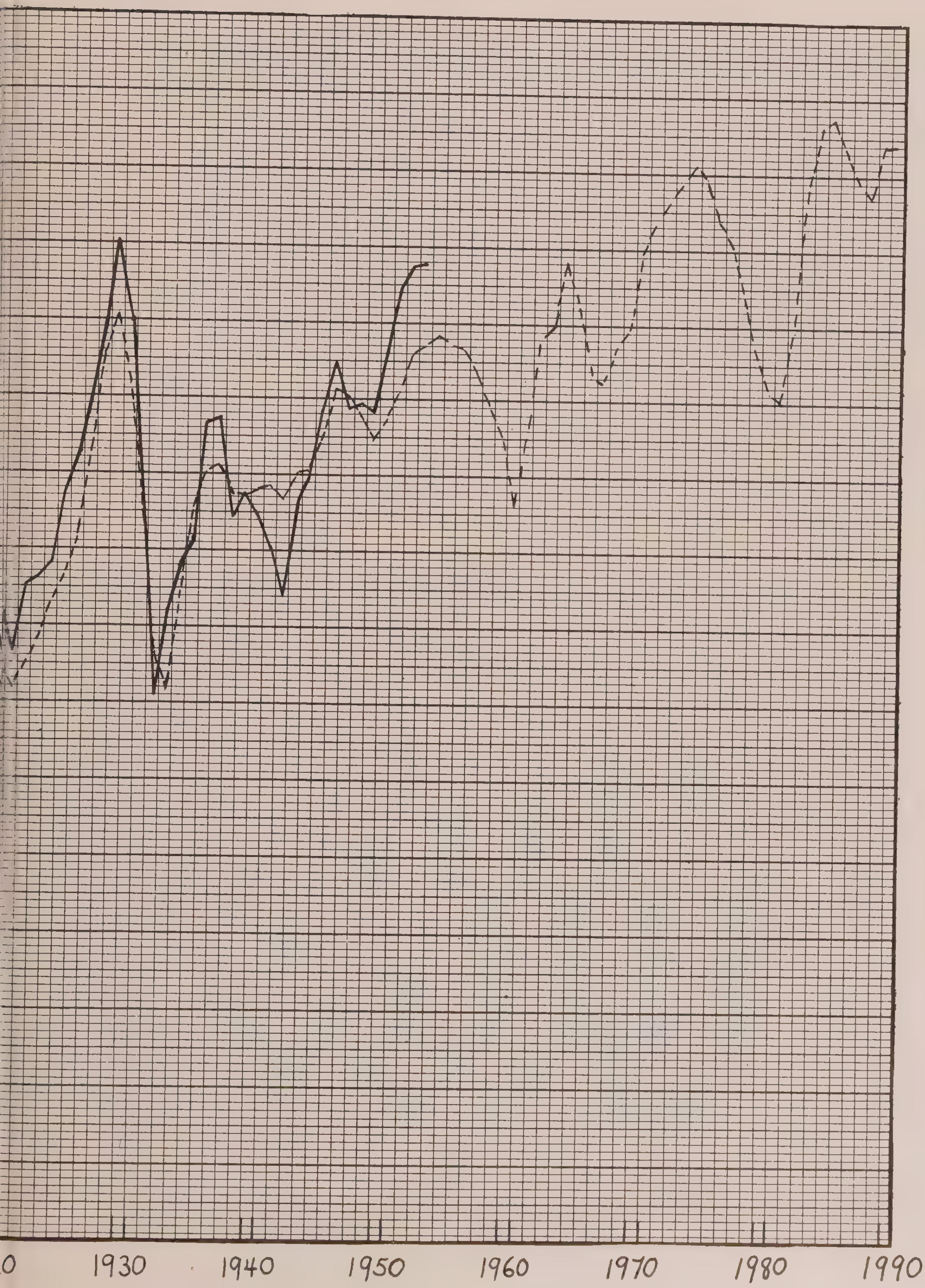


Fig. 4. Solid line, Common Stock Prices 1855—1953 (the same as Fig. 1).

Broken line, synthesis or combination of the 10 cycles and trend 1855—1990. (Ratio Scale.)


0
1930
1940
1950
1960
1970
1980
1990

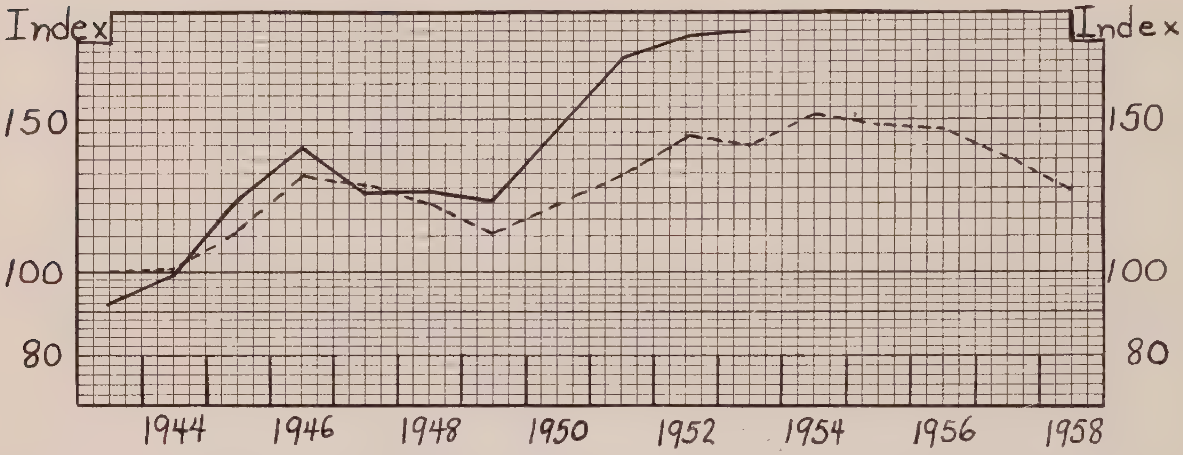


Fig. 5. Solid line 1943—1953, Standard and Poor's Corporation Combined Index (1935-39 = 100) as this index actually unfolded.

Broken line 1943—1958, a combination of the 10 cycles as determined in January 1944 and trend as determined in 1939. (Ratio Scale.)

Note that the combination of cycles and trend called for a peak in 1946, a trough in 1949, a faltering from 1952 to 1953, and a peak in 1954.

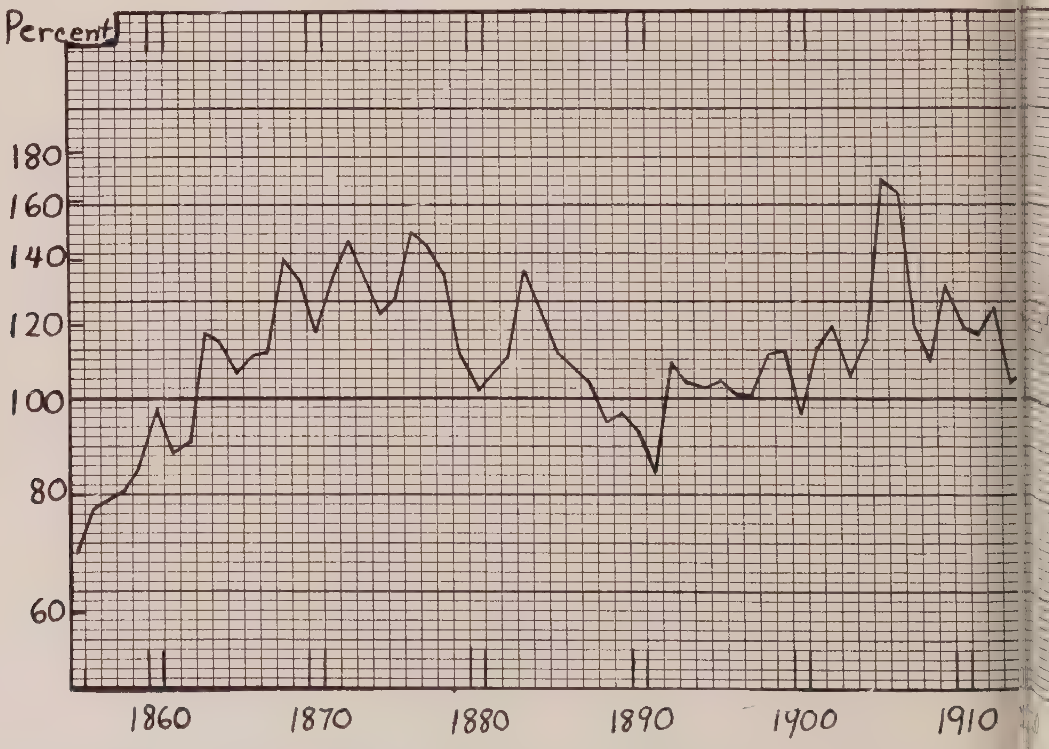


Fig. 7. The Remainder. The percentages that the actual stock market prices were, y
by year, of the synthesis. (Ratio Scale.)

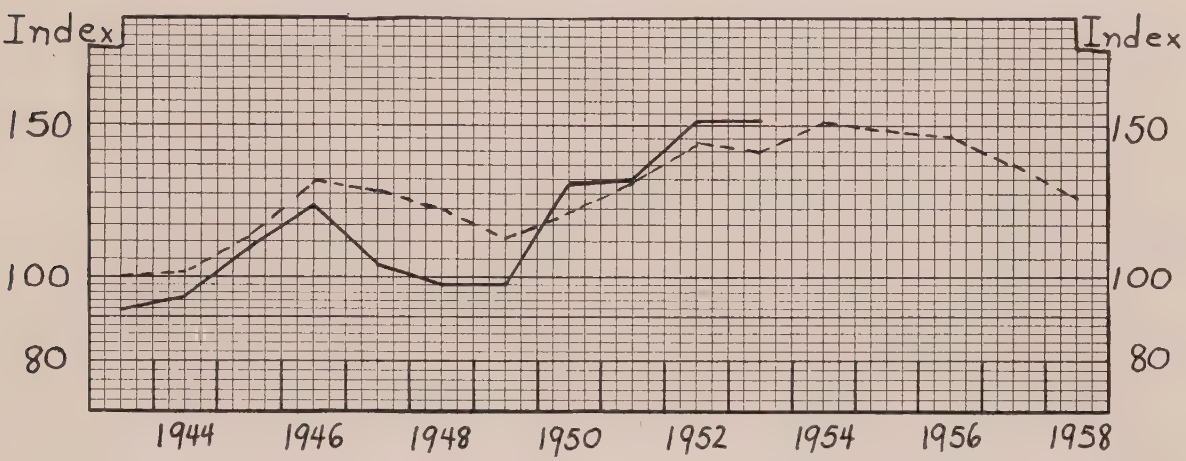
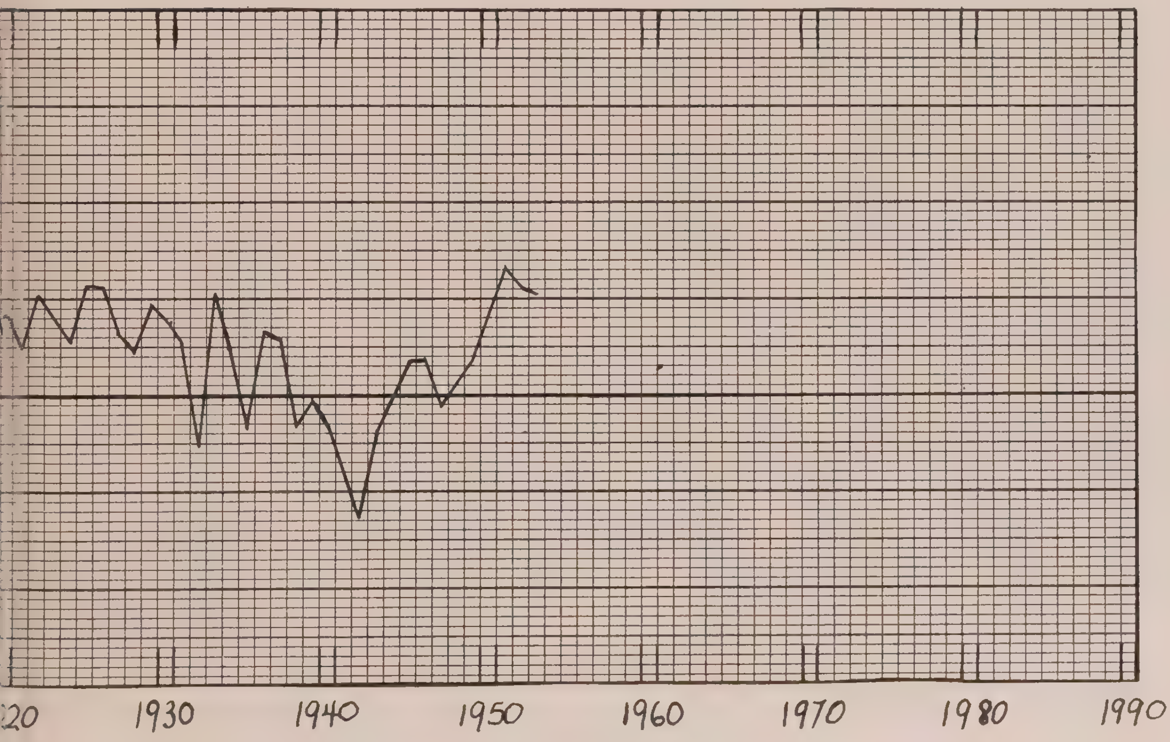


Fig. 6. Solid line 1943—1953, Standard and Poor's Corporation Combined Index (1935-39 = 100) converted to a gold basis 1943 = 100. This curve represents the prices of stocks in 1943 black market gold dollars.

Broken line 1943—1958, combination of the 10 cycles as determined in 1944 and trend as determined in 1939. This curve is the same as the broken line in Fig. 5. (Ratio Scale.)



future.

8. Finally, it is the simplest of all mathematical tricks to reproduce any time series, such as Fig. 2, to any degree of accuracy you wish by combining *enough* perfectly regular cycles of well defined properties.

That is why in 1944, even though the combination of the ten cycles and trend (Fig. 4) fairly well correspond to the actual values I was not too impressed with the result. Neither was the New York financial house for which I did the work. I put it away and forgot all about it. Then one day, in 1951 I think, I happened to come across it. I compared the projection with actual behavior, from 1943 forward, with the result shown in Figs. 5 and 6. I was highly gratified.

The arguments in *favor* of reliance on this forecast are as follows:

1. Cycles do keep on operating after discovery. Cycle forecasts do come true. Remember Samuel Benner's pig iron price forecast which came true over a 60 year period with a gain-loss ratio of 45 to 1.

If the rhythms are significant they can be expected to continue. (Being "significant" means that they are the result of periodic forces, not the result of random forces which just happened to occur at rhythmic intervals.

2. The discovered cycles really were present in the figures 1854—1943. Moreover each of them repeated rhythmically over that period of time.

3. Many of the discovered cycles are well known and have been found over much longer periods of time in other series of figures.

4. Granted that the excellence of the comparison 1944—1953 is partly a matter of luck, it is impossible to believe that the general configuration of the two curves is *all* a matter of luck. The evidence suggests that at least some of the isolated cycles must be continuing, and that the lengths and strengths and timing of these cycles must have been determined with pretty fair accuracy. That is, the amazing success over a 10 year period of the forecast made early in 1944 definitely suggest that the work has merit.

Conclusions

Let us now try to cast a balance:

The projection made in 1944, having worked for 10 years, cannot properly be ignored. This projection says in essence that we are at or near a peak, that 1954 is due to be *a* year of high, and that a substantial decline is due. This much I think we can and should accept.

The projection also tells us that after 1954 the chances of an *important* advance in the Standard and Poor's Corporation Combined Index are slim. I think we can accept this also as a statement of probability.

Finally, it is quite possible—even probable—that the forecast will continue to "work" and that a short sale of the Combined Index made at average prices for 1954 can later be covered at a profit, though I do not think the particular year of 1960, picked as the next year of low in 1944, 16 years in advance, is anything to bank on, nor do I take too much stock in the extent of the decline indicated.

As for 1954 being *the* year of crest, it would be surprising and a matter of pure luck if it should turn out so. You simply cannot ignore all cycles under 4 1/2 years and hope to hit the target on the button every time. By luck I did it twice. Do not count on my being able to do it again.

I think I can give you useful and valuable orientation. Do not abuse the results of my work by trying to make it do things it is not designed to do. Do use it within the limits of its usefulness, and profit!

E.R.D.

CONTINENTAL OIL COMPANY
CYCLES, TREND, AND FORECAST

NOW that another year of gross operating income of Continental Oil Company has become available it is possible to re-examine the cycles hitherto discovered in these figures, and perhaps get their values with slightly greater accuracy. Then, using the revised cycle values, the trend can be redetermined with perhaps a little greater accuracy, too.

Revisions of this sort should always be made at frequent intervals, just as in driving a car you true up your steering every few hundred feet or so.

Old and revised values of the 6-year cycle are as follows:

Year	Old Values	Revised Values
1930	110.6	110.0
1931	100.9	100.0
1932	96.4	92.5
1933	93.1	89.0
1934	95.2	92.5
1935	103.8	100.0
and so on	and repeat	and repeat

Old and revised values of the 3½-year cycle are as follows:

Year	Old Values	Revised Values
1930	106.0	105.3
1931	99.0	99.7
1932	96.0	96.3
1933	99.0	99.7
1934	106.0	105.3
1935	97.0	96.9
1936	97.0	96.9
and so on	and repeat	and repeat

As you can see there is no change in the timing of either of these cycles, and but very slight change in the amplitude. However, slight as these changes are, they, and the rather large income for last year, do make changes in the values of the trend.

Remember that the trend of anything measured in U. S. paper dollars is a mixture of growth and of inflation. Each of these two factors should be projected separately. Inflation should be projected by a political economist. Growth should be projected by someone who, in addition to knowing all about the cycles, knows the company and its prospects intimately. I do not qualify on either score. However, making the best guess of growth that I can, and for the sake of simplicity (and perhaps wishful thinking) assuming no further inflation, we obtain the trend values for recent and near future years shown in the following table. In the table is also shown the cycle values, their combined values, and the combination of trend and cycles. Finally there is shown the actual income and the percentage error of the combination in comparison with actual income.

Bear in mind that without much more knowledge than I have of probable future political action, probable future company action, and random occurrences which may effect company income for good or for evil, this projection is to be taken only in the most general sort of way. It does, however, indicate first that income for this year should be somewhat above income for last year and that if such an increase occurs we may have a relatively mild decline in income for the three years next following. By 1958, however, income should again be on the mend.

The policies of the company should reflect these probabilities.

E.R.D.

TABLE 1

Year	Trend in Millions of Dollars	6-Year Cycle in %	3½-Year Cycle in %	Combination of 6-Year and 3½-Year Cycles in %	Trends and Cycles in Millions of Dollars	Actual Income in Millions of Dollars	Error in %
1948	283	110.0	105.3	115.8	327.7	330.3	-0.8
1949	331	100.0	96.9	96.9	320.7	315.2	+1.7
1950	375	92.5	96.9	89.6	336.0	348.0	-3.4
1951	415	89.0	105.3	93.7	388.9	379.8	+2.4
1952	448	92.5	99.7	92.2	413.1	397.2	+4.0
1953	475	100.0	96.3	96.3	457.4	476.8	-4.1
1954	494	110.0	99.7	109.7	541.9	?	?
1955	505	100.0	105.3	105.3	531.8	?	?
1956	505	92.5	96.9	89.6	452.5	?	?
1957	505	89.0	96.9	86.2	435.3	?	?
1958	505	92.5	105.3	97.4	491.9	?	?

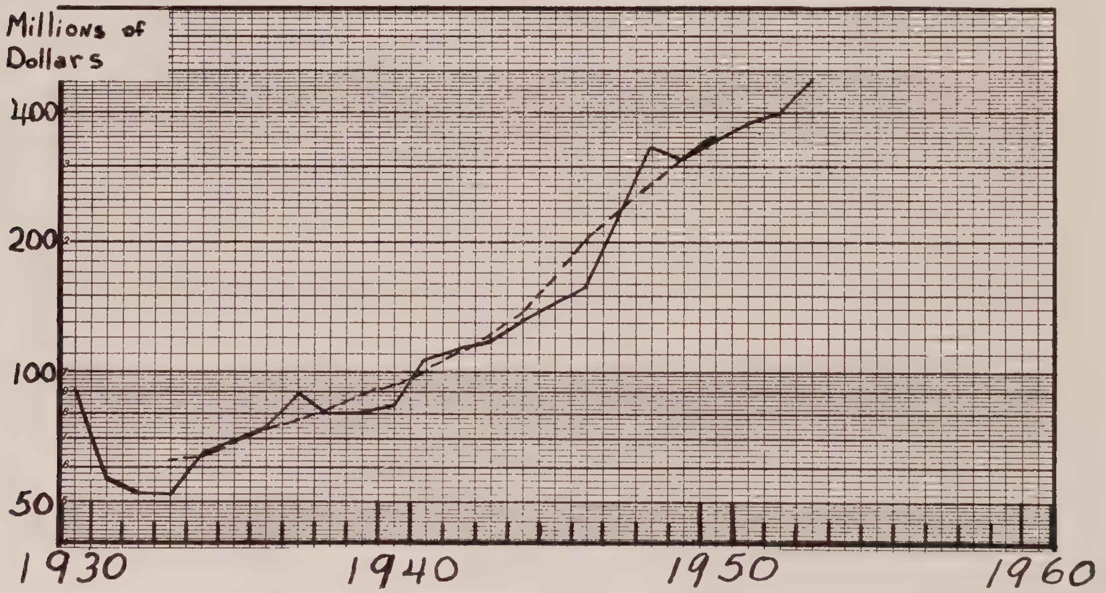


Fig. 1. The solid line shows the gross operating income of the Continental Oil Company by years 1930 through 1953.

The broken line (1933—1950) is the 6-year moving average trend of these figures. Such a trend stops three years short of each end of the series of figures. (Ratio Scale.)

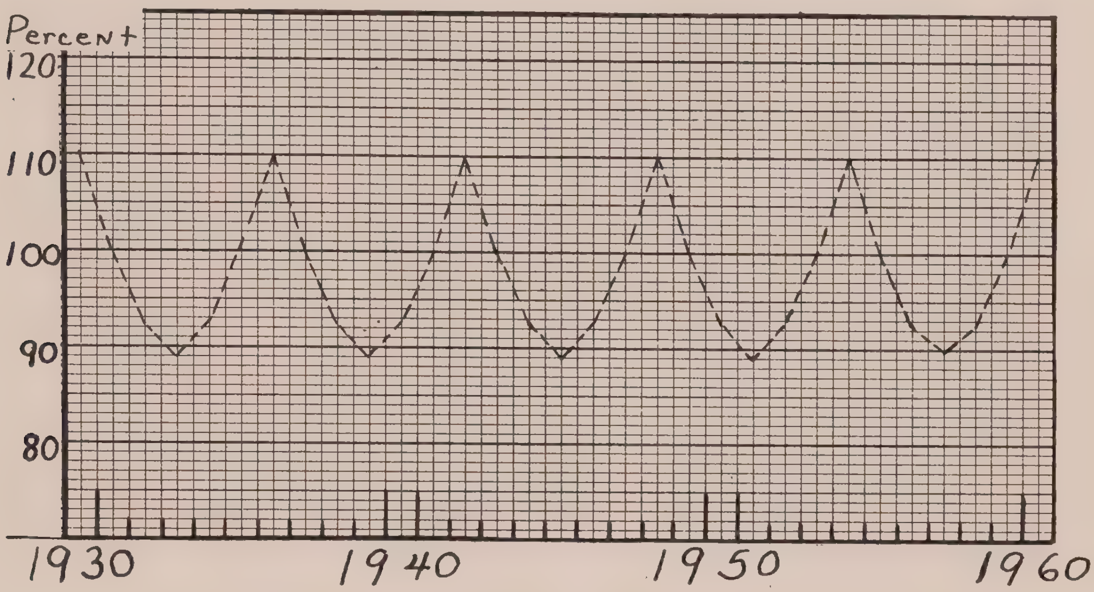


Fig. 2. The broken line shows the typical 6-year cycle in the gross operating income of the Continental Oil Company 1930—1953. This typical cycle has been projected to 1960.

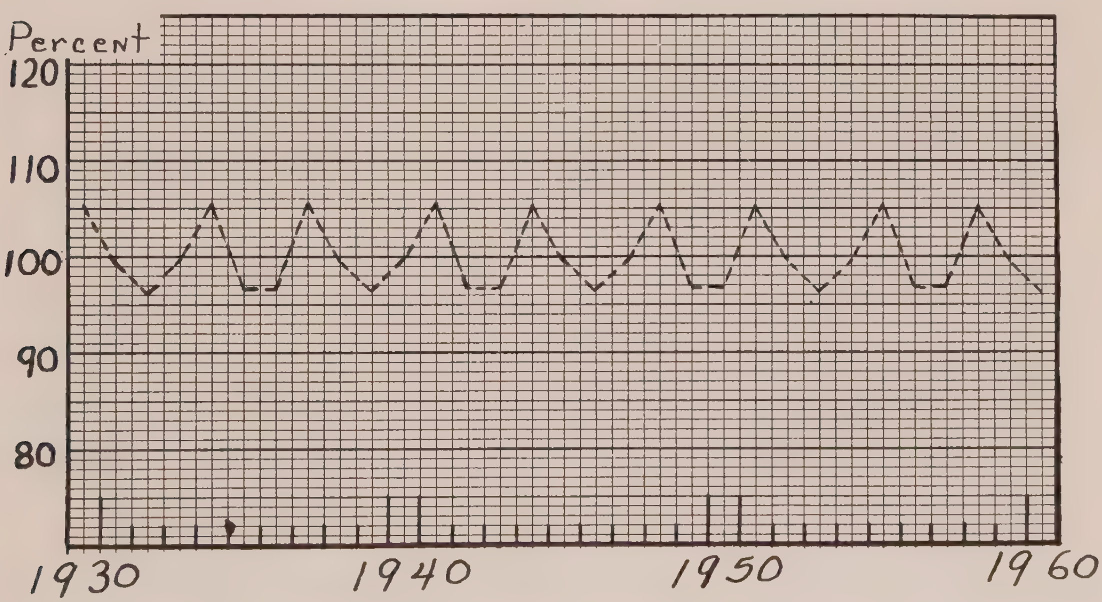


Fig. 3. The broken line above shows annual values of the typical 3½-year cycle in Continental Oil Company gross operating income 1930—1953. This typical cycle also has been projected to 1960.

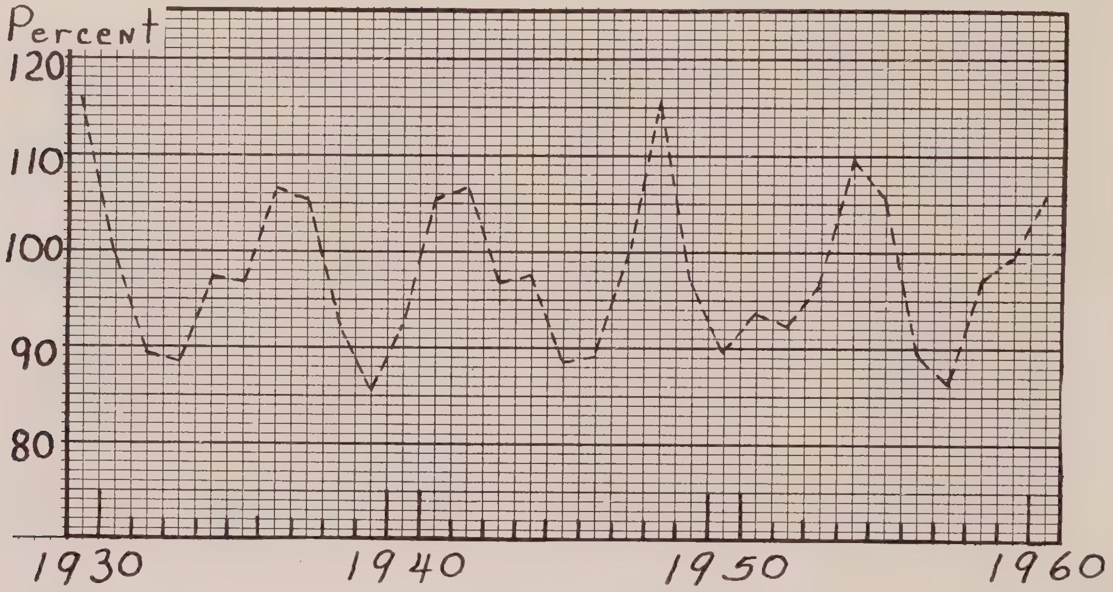


Fig. 4. The broken line shows the synthesis or combination of the 6-year cycle shown in Fig. 2 and the 3½-year cycle shown in Fig. 3.

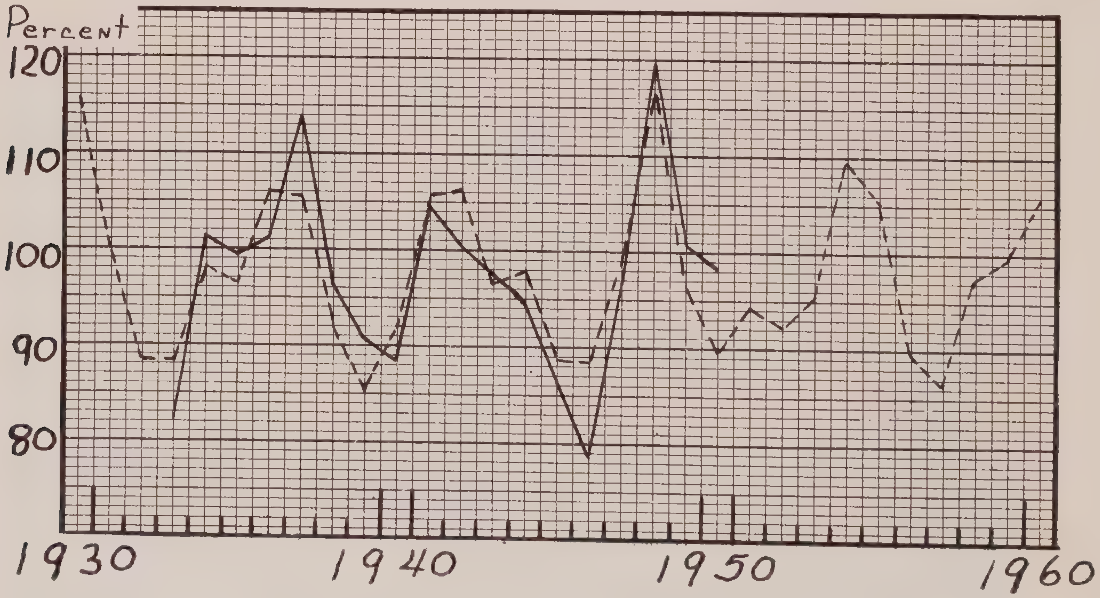


Fig. 5. The solid line shows the percentages that the values of the gross operating income of Continental Oil Company 1933—1959 are of their 6-year moving average trend. The percentage for any year represents the percentage that the income for that year is of the 6-year moving average trend for that year, i.e. it represents departures from trend.

The broken line 1930—1960 is a repetition of Fig. 4. It shows the synthesis or combination of the typical 6- and 3½-year cycles. It suggests probable future departures from trend.

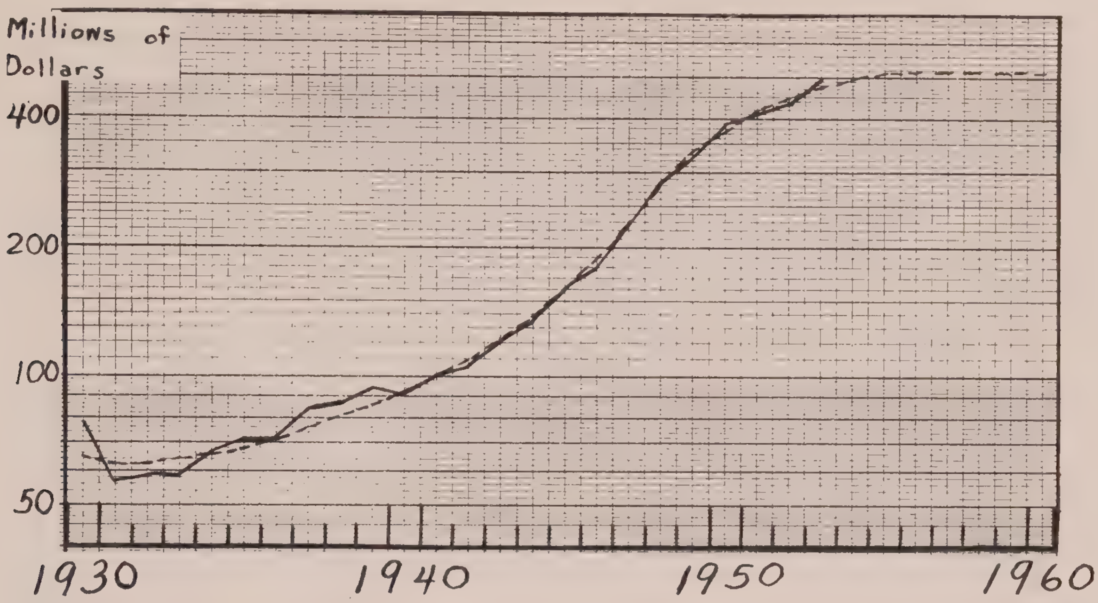


Fig. 6. The solid line shows gross operating income of Continental Oil Company after the adjustment for the effect of the perfectly regular 6-year and 3½-year cycles shown in Figs. 2 and 3 above. The broken line is a smooth trend fitted to these figures and projected into the future.

This trend and these projections should be revised each year. (Ratio Scale.)

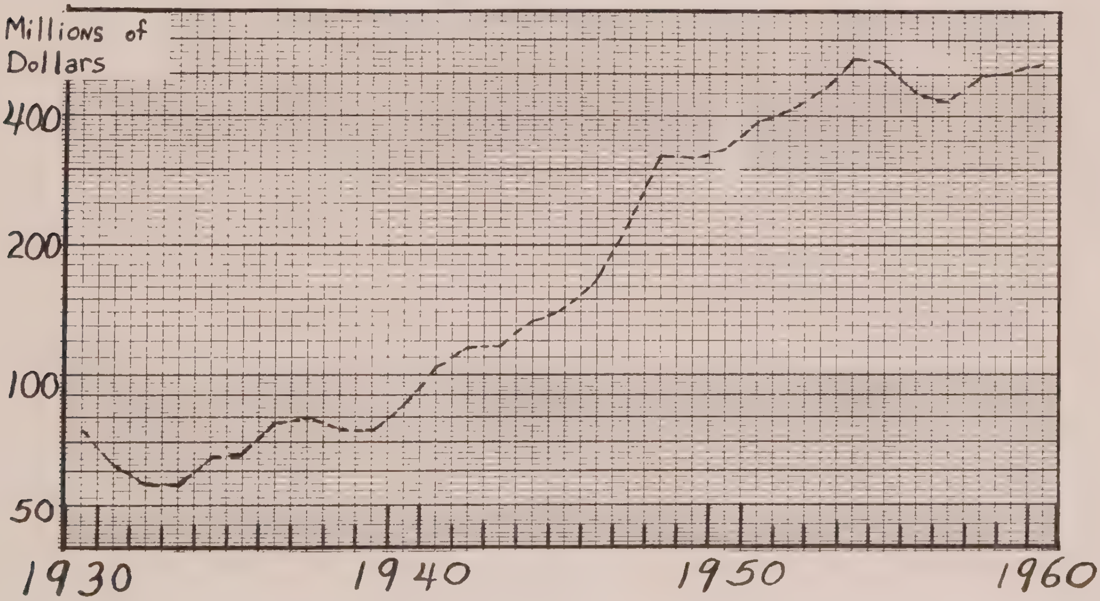


Fig. 7. The curve in this chart shows the combination of the trend charted in Fig. 6 and the combination of the 6- and 3½-year cycles, charted in Fig. 4. (Ratio Scale.)

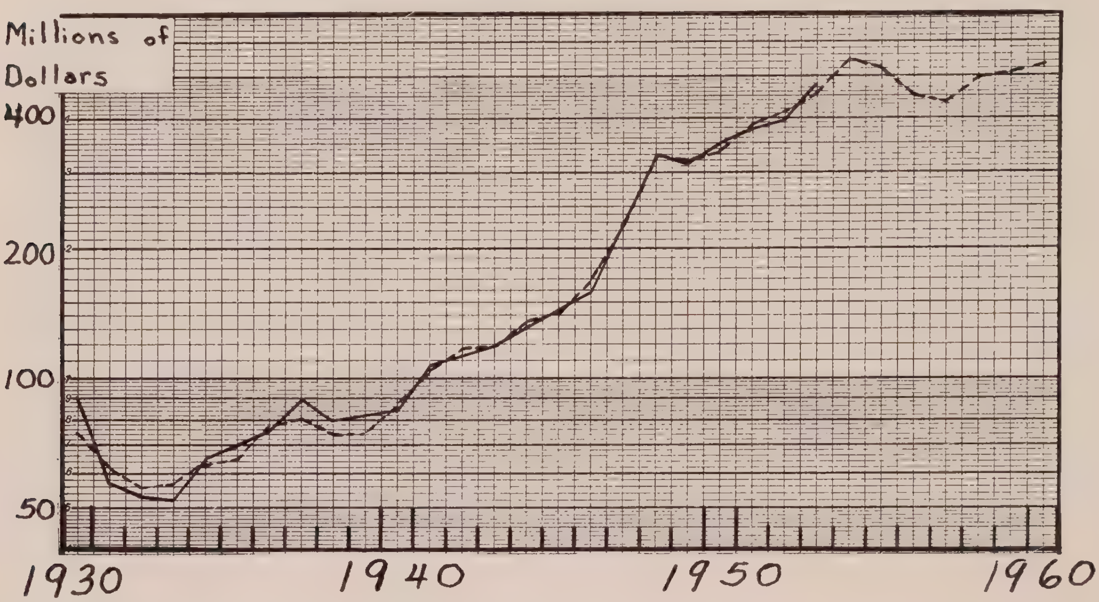


Fig. 8. The solid line shows gross operating income Continental Oil Company 1930—1953. It is the same as the solid line of Fig. 1.

The broken line represents the combination of the trend and the 6- and 3½-year cycles as charted in Fig. 7.

This chart shows the extent to which this smooth trend and these two cycles describe the gross operating income Continental Oil Company 1930—1953. If this trend and these cycles have been correctly determined and if the cycles continue, the projection of the broken line, 1953—1960, suggests the probabilities of the future. (Ratio Scale.)

EXCERPTS FROM

CYCLES

THE SCIENCE OF PREDICTION

(CHAPTER XI)

by **EDWARD R. DEWEY**
Director, Foundation for the Study of Cycles

and **EDWIN F. DAKIN**
Associate, Foundation for the Study of Cycles

TOGETHER WITH 1954 SUPPLEMENT

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XI

Analysis and Synthesis

To take a complex wave and analyze it into its simple components involves certain technical knowledge, and so does the task of synthesizing simple rhythms into a totality. It is not necessary that the reader of this study understand the techniques involved, and anyone desiring to avoid even the semblance of a mention of methods may prefer to skip this chapter. But the principles are simple, and he may find this understanding helpful before approaching — in the next chapter — a practical application of the knowledge to a specific business.

It should be made clear that in speaking of waves the word is used to describe what may be seen on the charts, and not to describe exactly what happens in society. As Sir James Jeans has said:

" A mathematical formula can never tell us what a thing is, but only how it behaves. . . . This point of view brings us relief from many of the difficulties and apparent inconsistencies of present day physics. We need no longer discuss whether light consists of particles or waves; we know all there is to be known about it if we have found a mathematical formula which accurately describes its behavior, and we can think of it as either particles or waves according to our mood and the convenience of the moment." *

Jeans tentatively identifies the *wave* with *probability,* in a beautifully clear passage. He says:

> Most physicists would, I think, agree that the seven-dimensional space in which the wave-mechanics pictures the meeting of two electrons is purely fictitious, in which case the waves which accompany the electrons must also be regarded as fictitious. . . . Yet . . . the waves of a single electron are real enough to record themselves on a photographic plate. . . .
>
> Some physicists meet this situation by regarding the electron-waves as waves of probability. When we speak of a tidal-wave we mean a material wave of water which wets everything in its path. When we speak of a heat-wave we mean something which, although not material, warms up everything in its path. But when the evening papers speak of a suicide-wave, they do not mean that each person in the path of the wave will commit suicide; they merely mean that the likelihood of his doing so is increased. If a suicide wave passes over London, the death-rate from suicide goes up; if it passes over Robinson Crusoe's island, the probability that the sole inhabitant will kill himself goes up. The waves which represent an electron in the wave-mechanics may, it is suggested, be probability-waves, whose intensity at any point measures the probability of the electron being at that point.*

Just as our reference to waves of light is a mathematical reference, not a sensory one, so is our reference to waves in the economy. The waves we talk about are a mathematical record of energies which — so far as people are concerned — appear in their lives as pay cuts or raises, or the courage to buy a new automobile, or the self-denial involved in making the old hat do, or the determination to see that the family moves into another neighborhood before Nellie becomes of school age. Trillions of such daily events, built up from people's decisions and impulses, are the energies that distribute themselves through society.

Now, distributions of energy are easily recorded as curves. Figure 1 shows a device called Galton's Quincunx, which puts small shot into the hopper at the top and lets them fall through a small hole, past interfering pegs, into bins at the bottom. They fall in a way that illustrates the physical basis of the normal frequency distribution law.

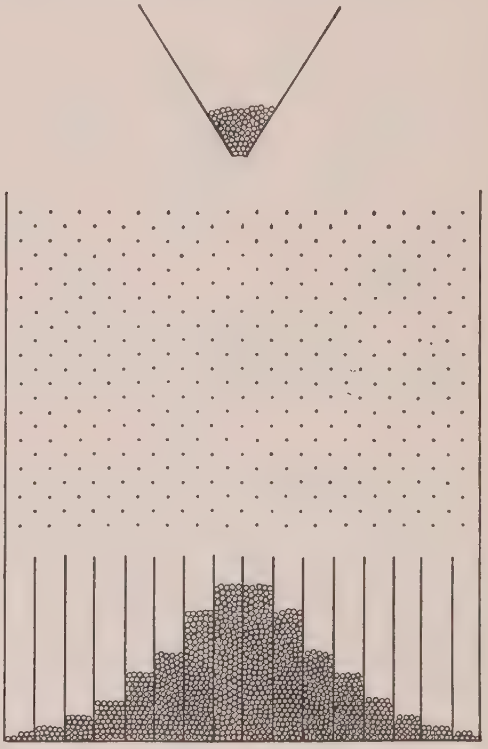

Fig. 1. Galton's Quincunx

A device for illustrating the physical basis of the normal frequency law (after Worthing and Geffner).

Figure 2 shows a graph of this same law of normal frequency distribution, in which you can recognize the wave form apparent in

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* *The Mysterious Universe* (The Macmillan Company and Cambridge University Press), pp. 951–2.

* *Ibid.*, p. 130.

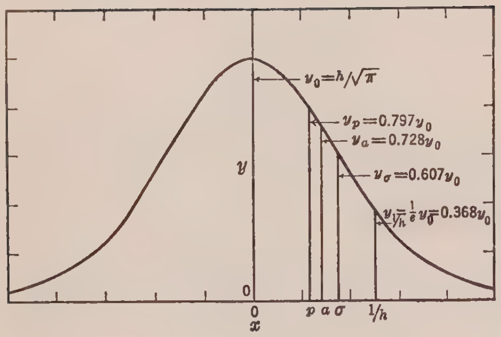

Fig. 2. Frequency Distribution

A graph of the law of normal frequency distribution, showing the Precision Indices (after Worthing and Geffner).

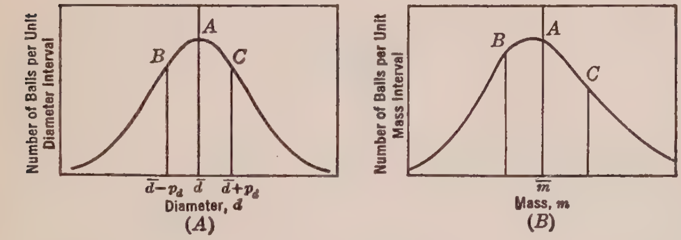

Fig. 3. Bearing Balls

Distribution of (*A*) the diameters and (*B*) the masses of a group of bearing balls. If *A* is assumed normal *B* is necessarily skewed. (After Worthing and Geffner.)

the Quincunx, the purpose of which is to show a wave form by mechanical means.

Figure 3 shows how the mass distribution may be "skewed," and hence nonnormal, when a group of bearing balls of equal density and sphericity, but of varying diameter, follow the law of normal frequency distribution. Were this an ordinary wave, one would say it is distorted. But even the "distortion" follows law.

These illustrations are reproduced here for just one reason: to show the reader without mathematical training how a phenomenon familiar in three dimensions may be interpreted in mathematical forms.

Something quite similar happens when pig iron production, say, becomes a chart on a piece of paper.

The vibrations caused by sounds may similarly be made into a chart. Probably most readers are familiar, from their school days, with the diagram of a simple sound wave as shown at the top of Fig. 4. The middle figure in this diagram shows a second sound wave. The bottom figure shows the two combined in what we call a synthesis.

Synthesis is, of course, the reverse of analysis. Figure 5 shows, at the top, the curve made by the tone of an organ pipe. The sine curves shown below are the harmonic components of this curve,

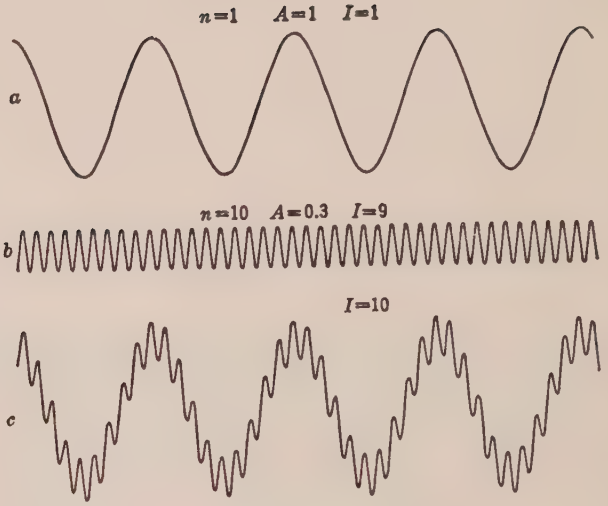

Fig. 4. Sound Synthesis — Two Components

Curves representing two simple sounds and their combination (after Miller).

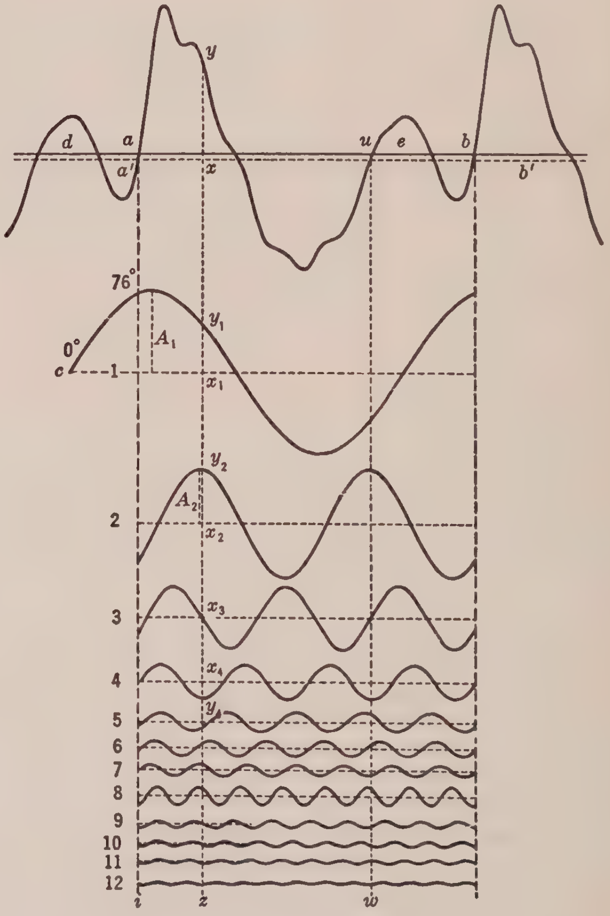

Fig. 5. Sound Synthesis — Twelve Components

An organ pipe curve (top) and its first twelve harmonic components (after Miller).

which has twelve components in all. The curve as shown on this chart is really the graphic interpretation of a mathematical equation, the wave length being equal to 400: *

$$\begin{aligned} y = A_0 &+ 96.5 \sin(\theta + 76^\circ) + 66.0 \sin(2\theta + 319^\circ) \\ &+ 36.5 \sin(3\theta + 337^\circ) + 19.2 \sin(4\theta + 354^\circ) \\ &+ 10.3 \sin(5\theta + 330^\circ) + 8.4 \sin(6\theta + 347^\circ) \\ &+ 6.4 \sin(7\theta + 354^\circ) + 8.9 \sin(8\theta + 290^\circ) \\ &+ 4.3 \sin(9\theta + 252^\circ) + 2.3 \sin(10\theta + 252^\circ) \\ &+ 2.2 \sin(11\theta + 230^\circ) + 1.5 \sin(12\theta + 211^\circ) \end{aligned}$$

The principle behind the prediction of tides, for long periods ahead, is quite comparable to the analysis of the pipe organ tone. Called the harmonic method, it was first devised by Sir William Thompson in 1867. The tidal curve is broken down into a number of constituent curves, each of which may be attributed to a periodic cause, mainly astronomical. These constituents are sine or cosine curves. Sine curves derive their name from the fact that, if you take a circle and plot the *sines* of the angles running from 0° to 360° as equally spaced ordinates, having due regard for signs, the resulting points form one complete wave of a sine curve. Repetitive waves found in natural phenomena — such as light and sound waves — are usually represented as sine curves or combinations of them. All sine curves are periodic, repeating themselves indefinitely. But some periodic curves are not sine curves. For an interesting discussion of the subject see the chapter on Cycles in *The Causes of Economic Fluctuations* by Dr. Willford I. King (Ronald Press).

When tidal curves are once analyzed, the constituents may be recombined by synthesis to predict the future tide for any time.

Figure 6 shows some of the constituents in the tide at Los Angeles. Captain Paul C. Whitney, of the U.S. Coast and Geodetic Survey, says of the work of analysis of such constituents:

> The actual computations necessary in making the harmonic analysis are quite laborious, although the work has been reduced by systematic methods. Even so, to determine, say, 24 constituents at a given place from a year's tidal series means computations involving about a million figures.**

The predicted tide at Los Angeles, California, for August 23–30, 1936; the observed tide; and four (M_2, S_2, K_1, and O_1) of the 21 constituents that went into the prediction (after Whitney).

The two rhythms shown at the bottom of Fig. 6 illustrate the tide as it was predicted from a synthesis of the constituent curves, and the tide as it was actually observed. Very close agreement is indicated. The illustration shows only 4 out of the 21 constituents used for this particular prediction.

The harmonic method of analysis, by which the observed tide curve is separated into the cosine curves, which are called constituents, is now used by all leading maritime nations in predicting tides. It is based on the principle that any *periodic* motion or oscillation can always be resolved into the sum of a series of simple harmonic motions.

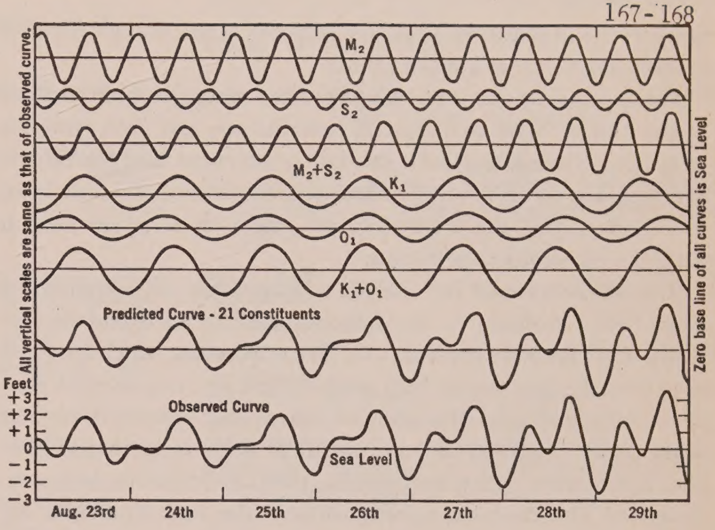

Fig. 6. Tide Prediction

Here we come upon a fact perhaps difficult but important to understand. The number of constituents in a harmonic curve is *theoretically* unlimited. Constituents are mere building blocks, as it were. They are something like the pieces in a jigsaw puzzle — you can keep on multiplying them indefinitely, by cutting them up into still more pieces. This does not mean that the curve is not " real." The theoretical infinity of constituents merely reflects the fact that you can theoretically divide anything into an infinite number of parts. In practice, we don't.

In predicting the tides, for instance, the constituents which are of practical importance depend on the precision required in the predictions. Each constituent is given a symbol or name, set by international usage. Thus the principal lunar constituent has a period of 12.42 hours, which is the semilunar day, and it is called M_2. The period of the principal solar constituent is 12 hours, or half the solar day, and is called S_2. The principal lunar daily constituent is called K_1, and the principal solar daily constituent is called O_1. The solar annual constituent is called Sa.

In Fig. 6, which we have already observed, the constituents M_2 and S_2 — after being traced separately — are shown combined into a curve. And K_1 and O_1 — pictured separately — are also shown combined. The predicted curve is a synthesis of these and 17 other constituents, or 21 in all.

Because the mathematical computations involved in using harmonic constants for tide predictions are so laborious, Thompson developed practical machines for rapidly analyzing and summing the various constituents. The predictor that has long been used by the U.S. Coast and Geodetic Survey is based on Thompson's original design, now much improved, and is constructed for summing 37 constituents. In about seven hours, it will make daily predictions for a year at a given point.

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* Reproduced by permission from Miller, *The Science of Musical Sounds* (The Macmillan Company), p. 124.

** "The Prediction of Tides," *U. S. Naval Institute Proceedings*, December, 1940, pp. 1723–4.

Prediction of such a curve thus involves two principles: analysis of the known curve to obtain its constituents; and then synthesis of the constituents to permit extending the curve into the future. Synthesis also serves to verify or prove the correctness of the analysis, by reconstructing the original curve — or a close approximation thereof — from the constituents.

The machines used for analysis and synthesis are employed in many fields. Professor A. A. Michelson devised an ingenious harmonic analyzer and synthesizer for 80 components, which has been used to study light waves. Such machines are also employed in electrical engineering for the study of alternating current waves and other periodic curves; they are useful in fields as various as electricity, acoustics, optics, astrophysics, naval architecture, and aerodynamics. The machines accomplish what the mathematicians can perform equally well by rather laborious methods which call for the resolving of involved equations.

Harmonic analysis is based on the mathematical principle called Fourier's Theorem, for which Baron J. B. J. Fourier first published the statement and proof in 1822. The Fourier Equation is not a tool for laymen untrained in mathematics; but it has been stated as follows, in language a layman can grasp, by Dr. Dayton Clarence Miller of the Case School of Applied Science:

> If any curve be given, having a wave length *l*, the same curve can always be reproduced and in one particular way only, by compounding simple harmonic curves of suitable amplitudes and phases, in general infinite in number, having the same axis, and having wave lengths of *l*, ½*l*, ⅓*l*, and successive aliquot parts of *l*; the given curve may have any arbitrary form whatever, including any number of straight portions, provided that the ordinate of the curve is always finite and that the projection on the axis of a point describing the curve moves always in the same direction.*

And Dr. Miller explains the application of the Fourier Equation as follows: " Many of the curves studied by this method can be exactly reproduced by compounding a limited number of the simple curves. For sound waves the number of components required is often more than ten, and rarely as many as thirty. In some arbitrary mathematical curves, a finite number of components gives only a more or less approximate representation, while an exact reproduction requires the infinite series of components." **

In the study of economic rhythms, harmonic analysis is only one of our tools. The method does give an over-all picture useful for preliminary and reference purposes, and also gives to any desired accuracy a mathematical description of the behavior. But harmonic analysis is of use primarily in connection with a wave — such as a sound wave — which is more or less exactly repetitive.

Harmonic analysis fails of itself to give the true length of a rhythm; it ignores individual variation and changes in amplitude and shift of phase. It also fails to unscramble a wave from its own almost-harmonics. Multiple harmonic analysis gives a much closer approximation to the length of the rhythm; but other than this, it has all the limitations of ordinary harmonic analysis.

Some twenty other methods of analysis are available. The periodogram is a method of approach to analysis which we can use when the problem is to determine dominating waves in a series of data the period of which may not belong to the Fourier sequence. This method is also a useful preliminary in determining rhythms.

For the student of economic fluctuations, the Hoskins Time Chart is a tool of great usefulness. It makes possible a rather complete analysis of a series with celerity and ease, and suggests and reveals rhythms that do not appear from the study of an ordinary graph through mere inspection or the use of a graduated rule. The method does have its limitations; it fails, for instance, to give either the shape or the amplitude of the wave, or to give the length as accurately as some of the other methods do. But these shortcomings can be met by supplementary use of the Moving Cycle Average, of the Periodic Table, and by other methods.

Unfortunately, we as yet have no machines generally available for conducting research work in economic rhythms on a scale matching the importance of the subject. The so-called Cyclograph exists in the form of only two machines — one is owned by its inventor in Chicago, and one is the property of Andrew E. Douglass in Tucson, Arizona.

Electrical spectrum analysis, if a machine and the skill to run it were available, would save vast amounts of time that must now be spent in multiple harmonic analysis. Electromechanical machines, if they were refined and made generally available, would save much time in periodogram construction, with the added advantage of finding the values for all positions for each period, as in the periodic table.

Such matters are mentioned here in passing, and only briefly, for the purpose of indicating to the general reader the scope of the problems involved. The problems themselves can safely be left in the hands of those with the technical training for their ultimate mastery. Our own immediate interest is confined, from this point on, to answering the questions with which our study began.

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* *The Science of Musical Sounds* (The Macmillan Company), p. 93.

** *Ibid*, p. 93.

POSTSCRIPT: The Foundation for the Study of Cycles is offering a correspondence course for the benefit of those who wish to master the subject of cycle analysis. If you are interested, write to the Director of the Foundation at East Brady, Pennsylvania.

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